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THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-149 University Ave. LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 32 Royal Bank Bldg.

Vol. V. Publication Office, Toronto—January, 1912 No. 1

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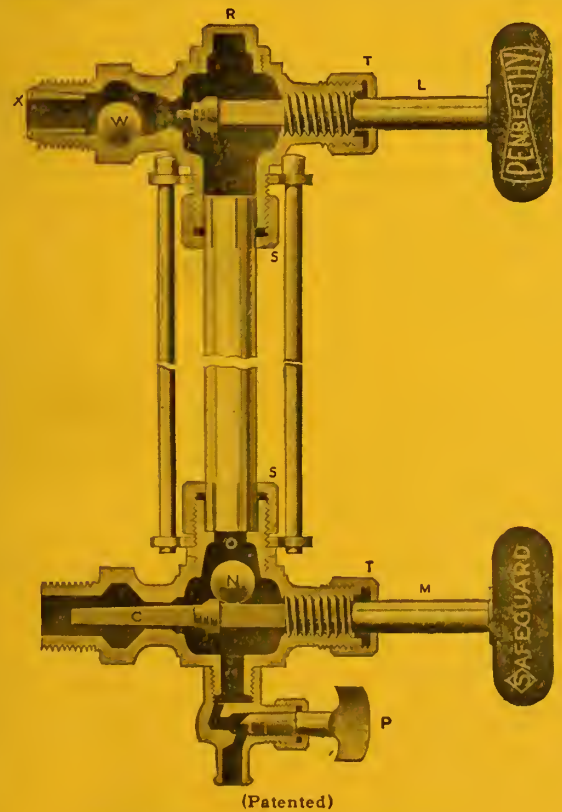
AUTOMATIC WATER GAGE



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Solid Construction. Simple Automatic Action
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It is the one certain protection against all accidents and injuries due to the breaking of the Gage Glasses.

The Upper Seat is designed to leak for purposes solely of sureness of operation at the proper time. Only dry steam escapes, and in small quantity, hurting no one. The leak equalizes the pressure in the glass and the boiler pressure, and the balls cannot stay seated unless glass is broken. This fact is positive, and any gage not made to leak on the upper arm is unsafe.

The "SAFEGUARD" is of solid construction throughout, and can be used with safety on very high steam pressures.

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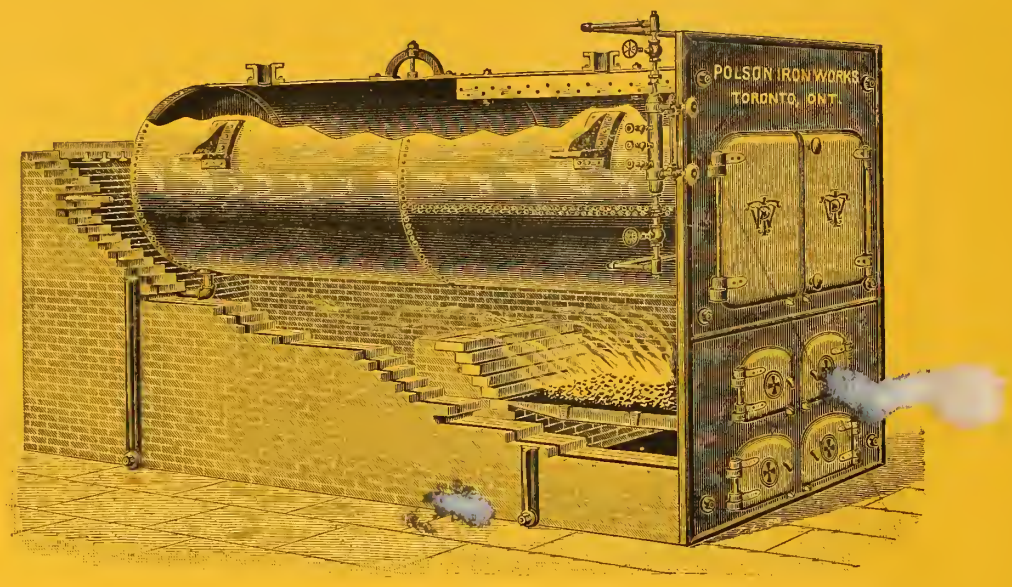

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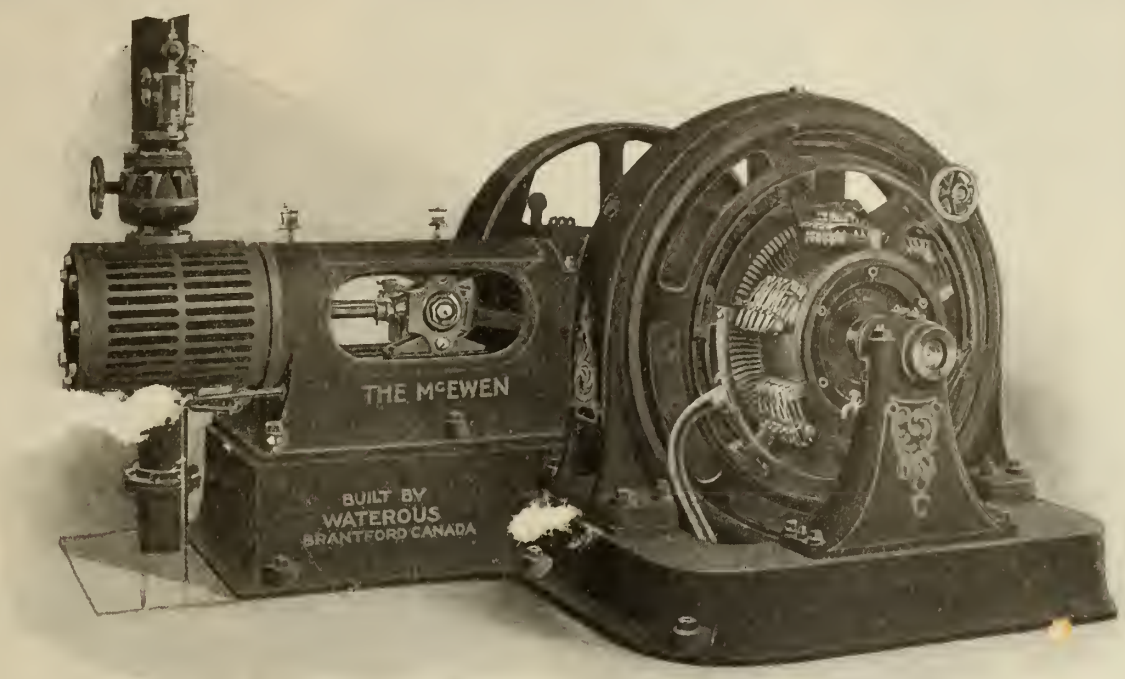

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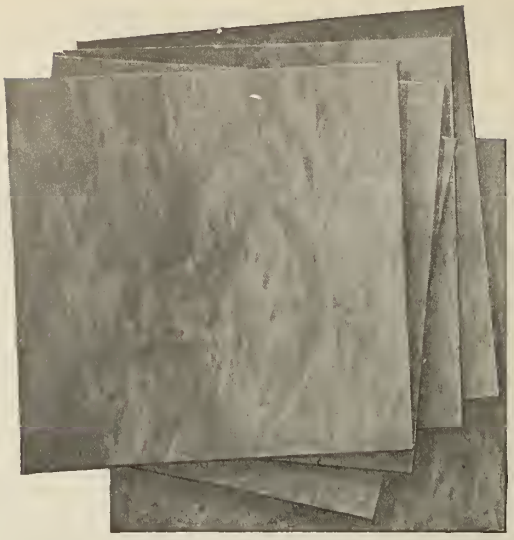

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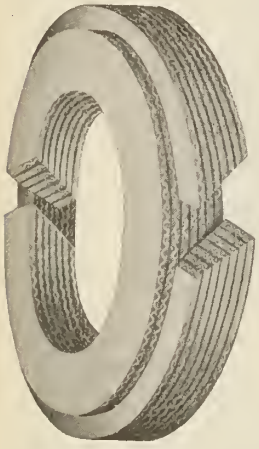

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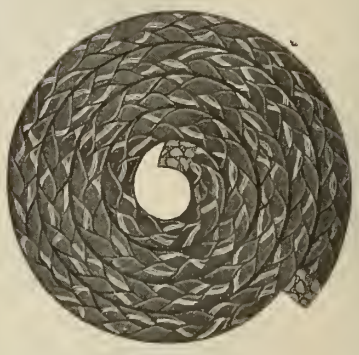

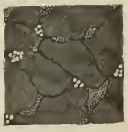

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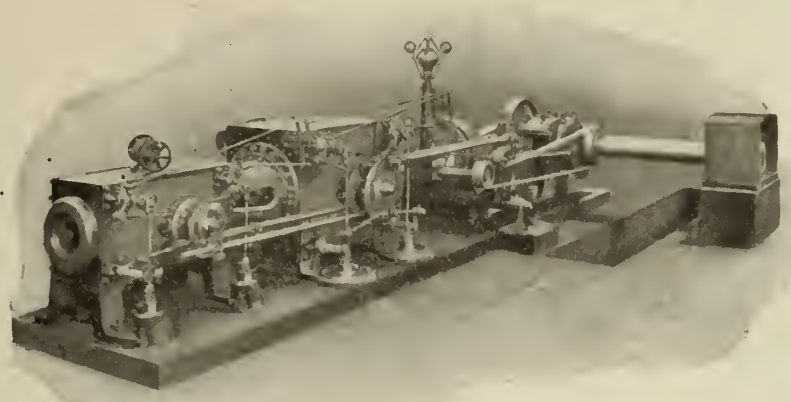

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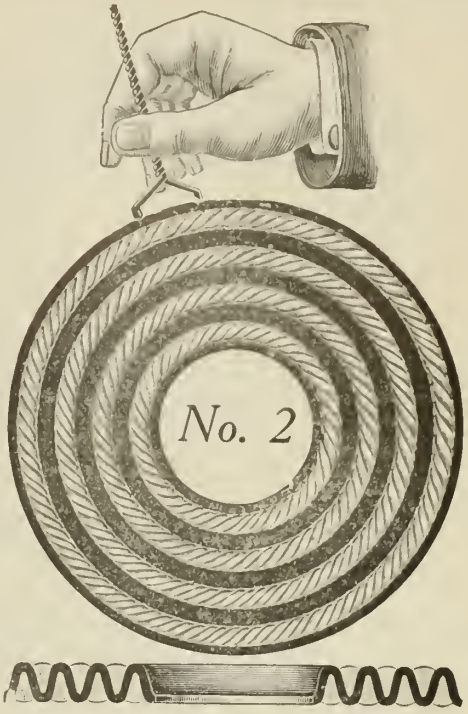

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Made of the celebrated Magnet compound, this packing is totally ***unaffected by heat, oil, liquor (ammonia), alkali, or by expansion or contraction.***

It is suitable for high or low pressure uses, particularly high, because of its heat-resisting properties. It neither becomes hard nor brittle. Retains its tough, elastic efficiency for months.

Magnet Sheet Packing won't *blow out.* It makes a tight joint that stays tight under air, hot or cold water or strain pressure.

Meets every requirement.

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Made also from the celebrated Magnet Compound. Forms a tight joint no matter how rough the surface may be—and it is

Pressure-Proof

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One of the big advantages of Magnet Gasket Tubing is that it may be cut any length to fit any size manhole or handhole, plate or pipe flange. Cut ends joined together with rubber core, making *continuous gasket.* Put up in convenient boxes with rubber core and tape.

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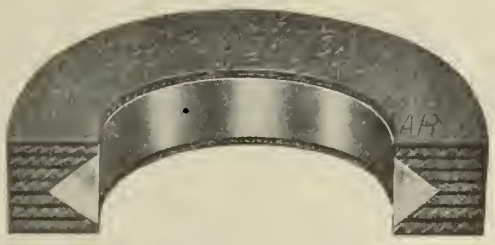
for high speed engines and oil pumps



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Specifically adapted for high pressure hydraulic work

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Extra ring to replace pure gum or rings of a similar nature

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for cold water pump piston rods out of line.

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GARLOCK BRAIDED METAL PACKING
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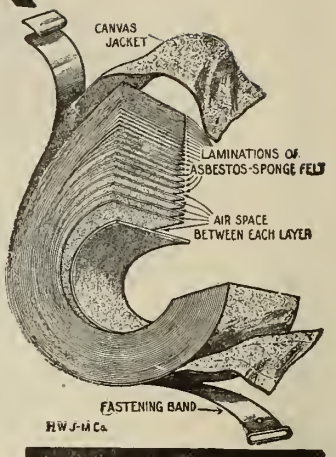

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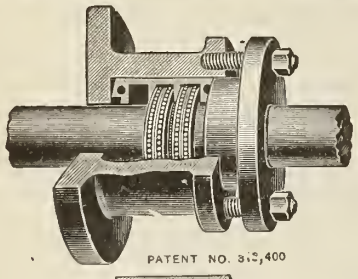

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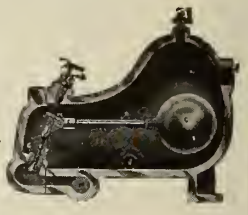

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LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

Guaranteed to stand steam temperature up to 550 degrees Fahr.
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Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
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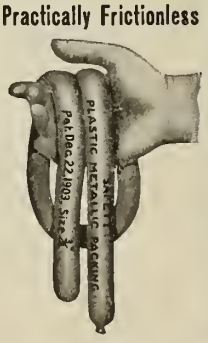

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You can't afford not to investigate POSITIVE Combined Jaw and Friction Clutches, Combination Split Pulleys, Shaft Hangers, Pillow Blocks, Compression Shaft Couplings, etc., if you want to handle or use the line that is so entirely different, better and far in advance of existing designs of such appliances, that it has revolutionized the transmission of power in manufacturing plants and has established a higher standard of dependability, durability, economy and efficiency in industrial operations.

The catalogue also contains some handy engineering tables and formulae. When you ask for it, don't fail to state, "Second edition of The POSITIVE Line."

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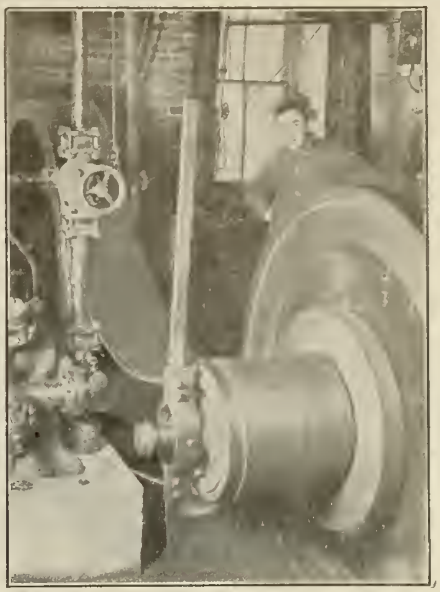

Some Figures on the Saving from Cling-Surface.

For example, take a power plant with engine delivering 100 brake horse power where the belt slips slightly—so little that you think it "isn't worth bothering about." Every one per cent. of slip on that belt means one horse power lost througbout the year.

Sames' Mechanical Engineers' Pocket Book, (p. 127) places the cost of power witb large compound condensing engines at from 0.8 to 1.0 cent per h.p. hour. If we suppose, in the above plant that power costs 0.9 cent, which would be low for a 100 h.p. engine, the cost of each per cent. of slip on the engine belt per year if the plant operated continually, would therefore be $.009 x 24 x 365= $78.84.

This is by no means an exaggeration, but a common loss of which the operator is often unaware, and which summed up for all tbe slipping belts in a plant can make an astounding figure. Yet Cling-Surface treatment will stop all the slip and its consequent expense at a cost not exceeding a wee small per cent. of the saving it effects, and will at the same time keep all belts in prime condition and waterproofed throughout the longest possible life.

Perhaps you don't know how much your belts are slipping. You can find out on any drive by dividing driver by driven pulley diameter and multiplying by r.p.m. of the driver. If this result is more than about 2 per cent. higher than the actual number of r.p.m. of the driven pulley, as found by the speed indicator, there is preventable slip that should have attention. Saturation of such a belt with Cling-Surface will not only save this lost power and save the belt, but will make possible running the belt easy or slack and thus remove from pulleys, shafting and bearings those useless strains that eat up lubricants and power and coal and the repair man's time.

Good managers and engineers get all out of systematic Cling-Surface treatment that is in it. There is neither difficulty in learning how this is done nor in seeing the actual results. Timely and consistent Cling-Surface treatment of any leather, cotton, balata, or rubber belts or transmission ropes invariably saves big money.

Our literature explains this and our liberal offer on a trial order

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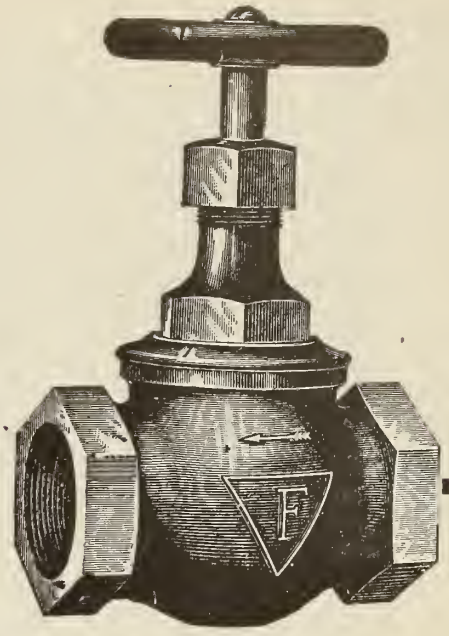

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"The World's Standard"

Will appeal to the discerning buyer. They are widely known and popular among all engineers—and deservedly so. In design they are simple—in construction and composition only the finest workmanship and best-grade bronze have been used. They are heavily built and well proportioned, being fully capable of standing rough treatment and any pressure up to that specified for each valve.

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TRADE JENKINS MARK
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"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for *genuine* "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL

A Perfect Joint

CAN BE EASILY MADE
WITH THE

"Dart" Union

A joint that cannot leak; that can be made quickly whether pipes are in or out of line—a joint that can be made time after time, without impairing the efficiency of the union.

The cut illustrates the union with a quarter section removed, showing the construction.

Bronze to Bronze

Bronze on each face of the joint makes corrosion impossible. The heavy malleable iron pipe ends and nut insure strength and durability.

To prove their economy and efficiency, we will send samples to responsible parties. All we ask is that they are given a thorough and severe test.

Eighteen years of success is the record of the "DART" union.

Sold by most dealers throughout Canada.

Made in all convenient types—screwed, flanged, tee and elbow, male and female.

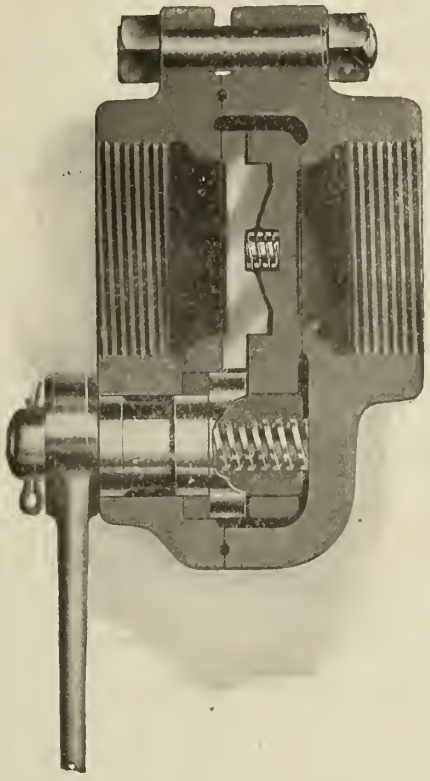
DART UNION CO., Limited

93-97 Niagara Street :: :: TORONTO, ONT.

EVERLASTING BLOW-OFF VALVE

250-LBS. PRESSURE

Simple
No Stuffing Box
Self-Grinding
Durable
Iron Body
Hard Bronze Parts
Efficient
Straight Through Blow
Holds High Pressure



Economical
It Never Leaks
No Repairing
Satisfactory
Needs No Attention
Easily Operated
Desirable
Long Life
Perfect Service

"IT NEVER LEAKS"

Order one and be the judge of its merits yourself. We will take your decision and refund money if not satisfied.

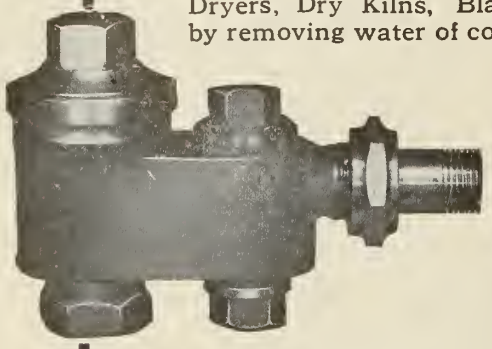
Engineering Specialties Company

1080 King Street West TORONTO, CANADA

THE "ECONOMIC"
VACUUM VALVE

Will Keep YOUR RADIATORS Always Hot With A Minimum Fuel Consumption

It will permit higher temperatures and increased efficiency of Dryers, Dry Kilns, Blast Heaters, Coil Stacks, Paper Cylinders, etc., by removing water of condensation.



Being a mechanically perfect Steam Trap, this Valve can be used equally well on either a Gravity or Vacuum System.

Engines supplying the exhaust will be absolutely free from back pressure.

The "ECONOMIC" Vacuum Valve has two chambers. One, the dirt chamber, where condensation is screened before entering the second chamber or valve proper.

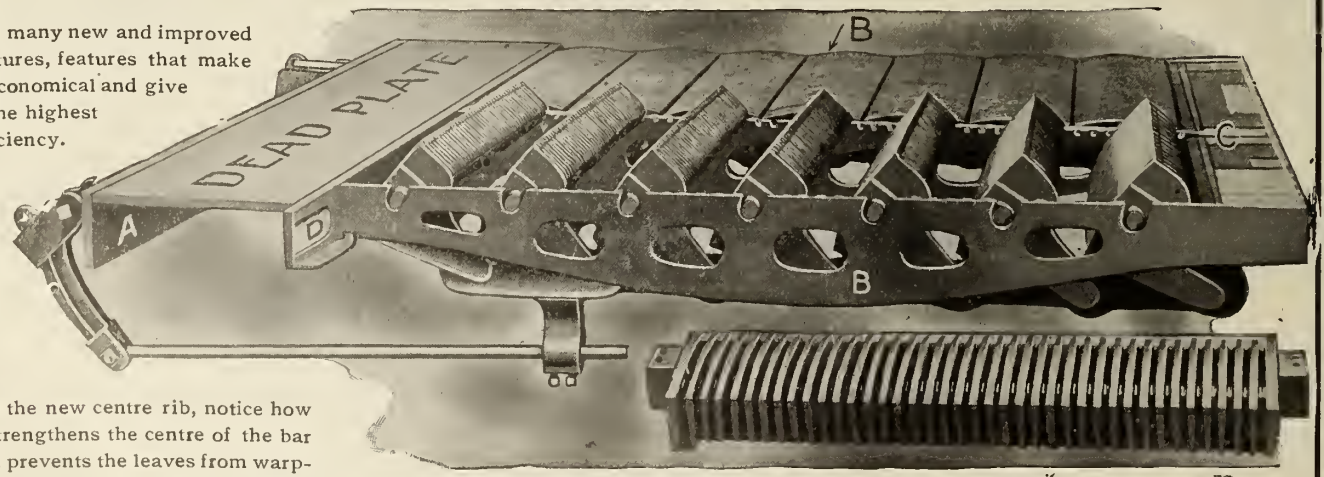
The dirt chamber can be cleaned in an instant by simply removing the cap at the bottom.

It will pay you to investigate this simple yet very effective valve. Write for testimonials and circulars.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.
186 QUEEN STREET EAST - - - - TORONTO, CANADA

The "Cyclone"
Shaking and Dumping Grate Bar

has many new and improved features, features that make it economical and give it the highest efficiency.



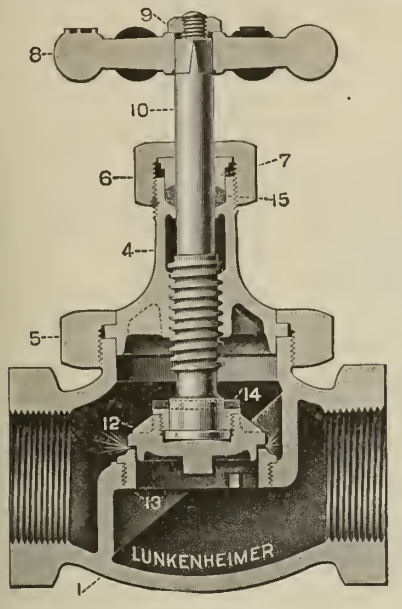
See the new centre rib, notice how it strengthens the centre of the bar and prevents the leaves from warping out of place. The "CYCLONE" bar has a shaking motion whereby we shake the ash off the centre of bar without letting the coal through. Get full information and prices.

Profit by the experience of others. Write for testimonials.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.
186 QUEEN STREET EAST - - - - TORONTO, CANADA

AGENTS:—ST. JOHN, N. B., F. W. Blizzard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 38 St. James Street. HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited. BERLIN, J. Hainsworth, 14 Foundry Street.

LUNKENHEIMER "RENEWO" VALVES



ARE POSITIVELY THE MOST DURABLE AND PRACTICAL MADE.

THE SEATING SURFACES CAN BE RE-GROUND and ALL PARTS SUBJECTED TO WEAR CAN BE RENEWED, including the DISC and SEAT. The SEAT is SELF-CLEANSING and is made of a hard, close-grained nickel.

The bronze used contains a high percentage of copper and tin. The improved construction of the disc PRESERVES THE SEATING FACES and PREVENTS WATER HAMMER.

LUNKENHEIMER "RENEWO" GLOBE, ANGLE and CROSS VALVES are made in two patterns—medium and extra heavy—and are guaranteed for working pressures up to 200 and 300 pounds per square inch, respectively. They are made in sizes ranging from ¼ to 3 inches inclusive.

"Most supply houses sell them—yours CAN—if they DONT or WONT—tell US."

The Lunkenheimer Company

Largest Manufacturers of high-grade Engineering Specialties in the World.

General Offices and Works: - - - - - CINCINNATI, OHIO, U.S.A.

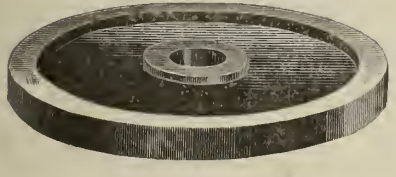
CHICAGO	NEW YORK	BOSTON	LONDON, S.E.
186 North Dearborn Street	64-68 Fulton Street	138 High Street	35 Great Dover Street

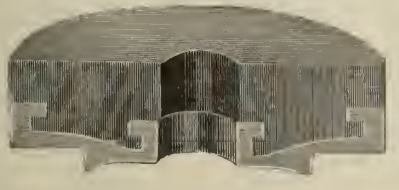
The ASBESTOS & RUBBER GOODS CO.

TORONTO, Ont.
141 King Street East,

MONTREAL, Que.
43 St. Francois Xavier Street,

L. R. & B. PUMP VALVES





Give better service than any other, and last longer.

Brass Casing prevents ports from forcing through.

Only best quality of material is used, and as wear takes place the rubber can be replaced until brass casing is reached, thereby giving full use of all the rubber.

It only needs a trial to convince you.

We also carry a full stock of all other engineers' supplies.

Write us before placing your orders.

NELSON
TRADE-MARK REGISTERED

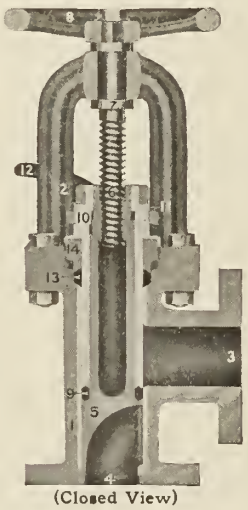
Blow-off Valve

Does not leak because it has no seat to get cut or clogged by dirt or scale.

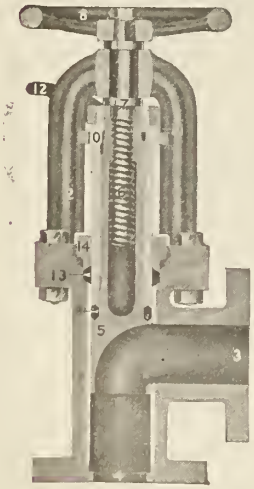
It is simple in design, highly efficient in operation.

Read This Guarantee

We guarantee the NELSON Blow-off Valve. It is patented. Its name is trade-marked. We couldn't afford to put our name on it if it was not right. If, after 60 days of use, you are not satisfied, send back the valve and we will refund the price you paid for it.



(Closed View)



(Open View)

Then Send This Coupon To-day

Nelson Valve Company 12-14 University St., Montreal

Please send me catalogue with full particulars and prices of NELSON Blow-off Valves.

.....

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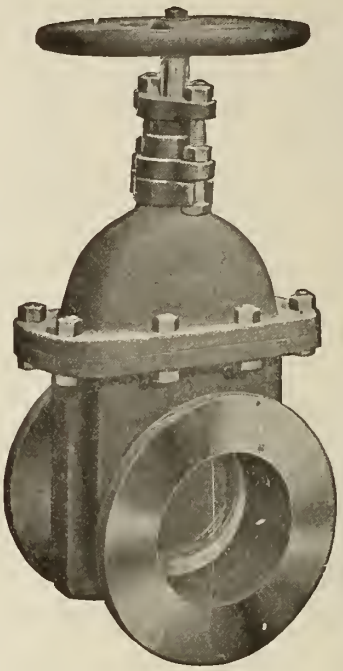


Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited
Valve Manufacturers
WALKERVILLE - ONTARIO

Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto

WAINWRIGHT WATER HEATERS

A Unit saved from the exhaust is worth two in the coal pile.

WAINWRIGHT WATER HEATERS
are designed specially to fulfill the requirements of Bleacheries, Dyehouses, Paper Mills, Laundries

ALBERGER CONDENSOR CO.
140 Cedar Street, NEW YORK CITY
Agents: CANADIAN FAIRBANKS CO., Limited
Montreal, Toronto, Winnipeg, Vancouver

Even though you have only three or four valves in your plant

THE SKINNER Valve Re-seating Tool

will redeem its cost in a very short time.

½″ to 2″ . .	$20.00	f. o. b.
½″ to 3″ . .	$30.00	MONTREAL

PACKED IN NEAT WOODEN BOX.

GET ONE. YOU'LL LIKE IT.

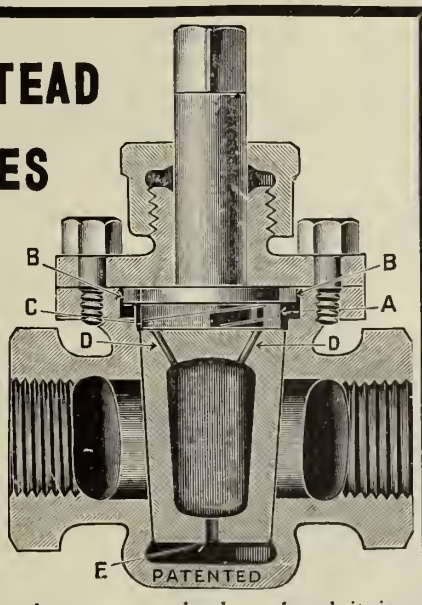
H. L. Peiler & Company

MONTREAL 380 St. James St. — TORONTO 69 Adelaide St. E. — MONCTON, N.B. McLeod Building

WESTERN AGENTS:
W. E. SKINNER, Limited - 618 Somerset Building, Winnipeg

HOMESTEAD VALVES

Have no Equal for Simplicity and Durability



They are unexcelled for any service involving the handling of high pressures in steam, gas, water or hydraulic work The seats are absolutely protected against wear. The plug is balanced and held in place by pressure when open, and when closed it is locked in the seat by our patent wedging cam. That's what makes Homestead Valves outwear all others.

A quarter turn opens or closes the valve—no waste of time or energy.

A catalogue describing Homestead Valves is yours if you tell us where to send it.

Homestead Valve Mfg. Co.
Works: HOMESTEAD, PA.
P.O. Box 1754, Pittsburg

THE "IDEAL" PACKLESS VALVE

Should Interest You, Mr. Engineer.

It is a valve that needs no attention, after once installed, in the way of packings.

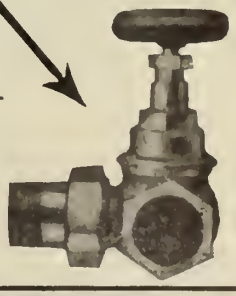
Does away with expenses in keeping up an ordinary valve and prevents accidents that are liable to occur by escaping steam, water, or gas.

It is guaranteed not to leak under any pressure up to 200 pounds.

The "Ideal" Packless Valve is neat in design and construction and is made to meet the requirements of every boiler room.

We invite comparison between any of our products and those of other manufacturers whether in material or workmanship.

You will save much trouble by writing us.



The Ideal Packless Valve Co., Ltd.
WALKERVILLE, ONT.

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FOR POWER HOUSE AND FACTORY

WE CARRY IN STOCK FOR IMMEDIATE SHIPMENT
A COMPLETE STOCK OF

SUNBEAM LAMPS STEEL REFLECTORS
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The services of our illuminating experts are yours for the asking—estimates and recommendations on the lighting equipment best adapted for your needs. Send for Bulletin 2068.

THE Northern Electric
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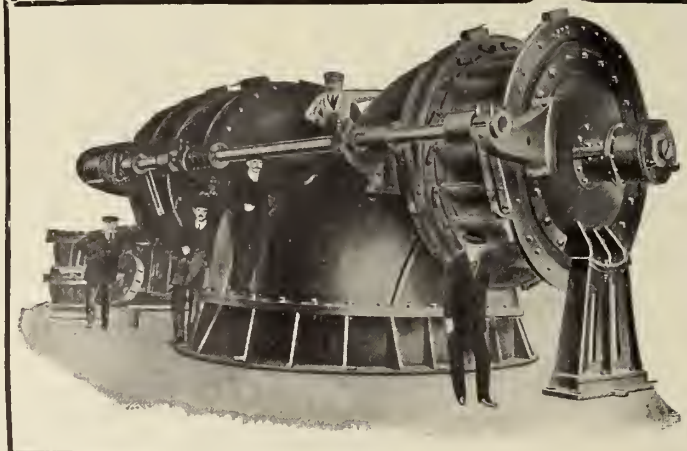
Manufacturer and Supplier of all apparatus and equipment used in the construction, operation and maintenance of Telephone, Fire Alarm and Electric Railway Plants. Address our nearest house.

MONTREAL TORONTO WINNIPEG REGINA CALGARY VANCOUVER

WATER TURBINES
—AND—
GOVERNORS

All Sizes

Maximum Efficiency



All Heads

Ideal Control

ASK FOR PARTICULARS FROM
THE CANADIAN BOVING CO., LTD.
164 BAY STREET, TORONTO.
Branch Office for British Columbia, 427 Seymour St., Vancouver

Marsh and American

Steam and Power Pumping Machinery

Here are a few reasons why you can purchase Marsh and American Pumps with the confidence that comes only with the feeling that you are getting the very best.

GUARANTEE: Every Marsh and American Pump is fully guaranteed to satisfactorily meet the service for which it is recommended.

BRONZE FITTINGS: Complete bronze fittings are part of the equipment of every pump.

SIMPLICITY: On the Marsh Pumps there is no outside valve motion while the steam valve with the exception of the steam piston itself is the only moving part on the steam end.

ECONOMY: Marsh and American Pumps are guaranteed to operate on about one third less steam than any duplex pump on the market. Only just enough steam is admitted to the steam cylinder to do the required work.

Our new 188 page No. 18 catalog contains a great deal of information about pumping machinery that will be of interest to you. Write to-day for your copy.

Marsh Boiler Feed Pump.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Hallman & Peniston Machinery Co., Vancouver, B.C
Mechanics' Supply Co., Quebec, Que.
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AMERICAN STEAM PUMP COMPANY

Battle Creek, Mich.

Deming Power Pumps

Made in Many Sizes

For all Pumping Conditions

Automatic Sprinkler System Pumps.
Boiler Feed Pumps.
Combination Water and Air Pumps.
Deep Well Working Heads.
Electric Driven Triplex Pumps.
Gas Engine Driven Pumps.
Paper Makers' Pumps.
Railway Water Supply Pumps.
Tank Pumps for light, medium or heavy service.
Waterworks Pumps.

and including many others. The entire line is shown in our catalogue "H."

Deming General Service Triplex Power Pump for operation by belt. Requires but little power for operation.

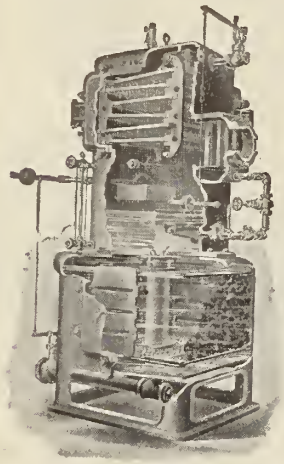
The Deming Company

SALEM - - - OHIO, U.S.A.

HAND AND POWER PUMPS OF ALL KINDS.

Agencies—Henion & Hubbell, Chicago, Ill.; Darling Bros., Montreal, P.Q., Can.; Morgan Engineering Co., Seattle, Wash.; Root, Neal Co., Buffalo, N.Y.

A Pure Boiler Feed Water Is Essential to Economy



You can't get over the fact that impure water will soon interfere with the efficiency of your boiler and seriously add to your fuel consumption. There is only one way to insure boiler efficiency and fuel economy---that is, purify your boiler feed with a

WEBSTER FEED WATER HEATER, PURIFIER and FILTER.

Let us make one specially suited for the feed water used in your boilers. Almost every case calls for special treatment. Our capacity and experience is indicated by the fact that over 3,000,000 h.p. of Webster Heaters are in use to-day.

WRITE FOR LITERATURE

Darling Bros., Limited

15 Ottawa St. - MONTREAL, P.Q.

Toronto, Ont. St. John, N.B. Winnipeg, Man.
Vancouver, B.C., Frank Darling & Co., Agents.

Minimize YOUR Fuel Bills

By Using

The "OTIS"

TUBULAR FEED WATER HEATER

With the "Otis" heater you can heat your feed water to a boiling point with your exhaust steam and save a surprisingly large amount of fuel.

Every "Otis" is equipped with a Separator and Purifier which gathers and extracts all oil from the exhaust.

The "Otis" is very durable, practical and highly efficient.

Write us for fuller particulars and catalog.

The Stewart Heater Co.

189 Norfolk Ave., Buffalo, N.Y., U.S.A.

BLACKBURN-SMITH FEED WATER FILTERS

Oil, grease and other foreign matter held in suspension in the feed-water are the causes of serious boiler troubles if not removed. The Blackburn-Smith Feed-water Filter, manufactured by Messrs. James Beggs & Company, will remedy these difficulties. Their filters are in successful service in the largest plants in the United States and Canada.

Canadian Sales Agents:

EADIE-DOUGLAS LIMITED

Montreal Toronto Ottawa Winnipeg

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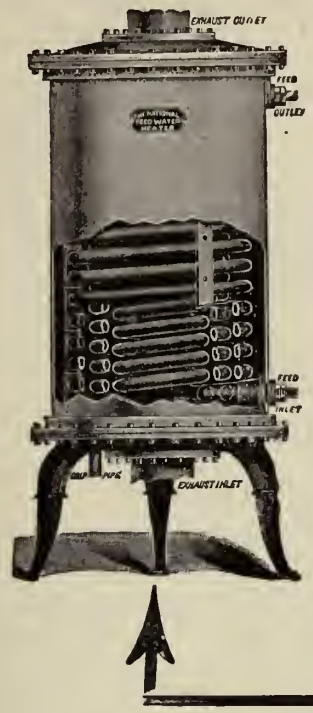


Want to Save Fuel?

THE NATIONAL Feed Water Heater

The cost of this heater cannot be compared with the great savings which result from its use.

It is the simplest and most efficient heater on the market. No inside tubes to leak, no back pressure. Water cannot come in contact with the shell or iron.

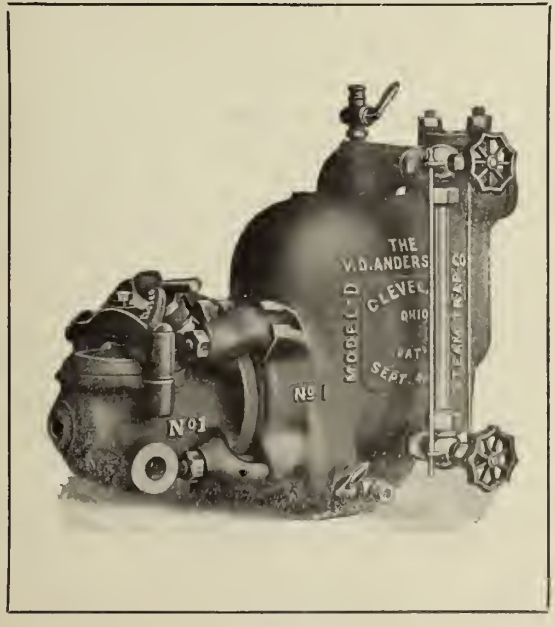
Most up-to-date engineers use the "NATIONAL" and are highly pleased with its service.

Get fuller information at once. It will pay you.

The National Pipe Bending Co.

91 Lloyd Street, NEW HAVEN, CONN., U.S.A.

The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

DIVIDENDS

are based on net earnings. Keen

COMPETITION

means a close eye on manufacturing costs. We can make a reduction in your fuel bill, lengthen the life of your boilers and give your engine greater efficiency. Does that sound like

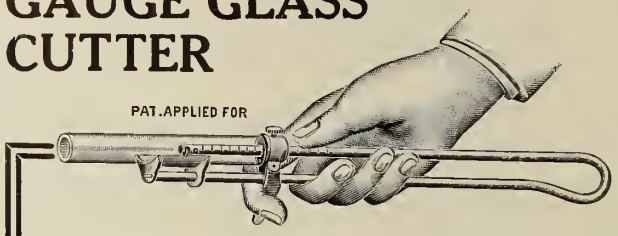
DIVIDENDS ?

Enquire, either personally or by letter, concerning our

—**Automatic Boiler Feed Control.**
—**Automatic Hot Water Control.**
—**Automatic Steam and Stoker Control.**
—**Automatic Temperature Regulator.**
—**Automatic Pump Governor.**

Heat and Pressure Control Co.
603 KENT BUILDING, TORONTO

The "FLETCHER"
GAUGE GLASS CUTTER



Operates the Quickest, Easiest and is Most Accurate

It has an Improved Lever Attachment, with Large Rest and highest grade Diamond Cutter, which assure an article of superior quality.

Its construction makes it the most valuable device on the market for cutting glass tubing at the required length.

The "FLETCHER" is noted for its simplicity, durability and perfection, and is a necessity for every engine room.

OUR PRICES WILL PLEASE YOU---WRITE AT ONCE.

Worcester Brush & Scraper Co.
WORCESTER, MASS., U.S.A.

QUALITY
Counts in
Gauge Glasses

Bishops ADAMANT

will withstand the highest Steam Pressures and all variations of temperature.

ADAMANT GLASSES

have been tested under all conditions and have proved their superiority over all others.

Write us for Further Particulars

J. R. Baxter & Co.
Mill Supplies MONTREAL

We Will Loan You a
Vulcan Soot Cleaner
For Thirty Days' Trial

The heating surface of your boilers is, in a way, the foundation of your whole plant. Every square foot of this heating surface has cost you money, and this surface is limited. If half or more of this surface is coated with soot you cannot get the greatest HEAT ABSORPTION, nor can you get the full-rated boiler efficiency. Consider the SOOT PROBLEM. It is simply a case of Soot vs. Efficiency—which will you have ?

The big railway companies are buying from $5,000 to $20,000 worth of our Cleaners every year. Why ? Because they get their money back in coal saved in from three to six months.

ASK US ABOUT IT TO-DAY.

VULCAN
TUBE CLEANING SYSTEMS LIMITED

4-11 Bonsecours St. MONTREAL

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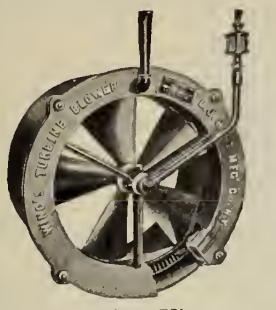


Exterior View
Blower Complete

"Typhoon" Turbine Blower

Will Increase The Available Heat Units in Every Shovel Of Coal You Put In The Furnace

It produces a powerful forced draft, which passes under the grate and gives a combustion that cannot be obtained by any other mechanical or forced draft system.

With this draft the cheapest grades of coal can be used effectively, which means a great saving in fuel bills.

Besides insuring economy in fuel and complete combustion it increases the boiler capacity, occupies no floor space, reduces boiler strains, and cannot be affected by weather conditions.

An inquiry will prove valuable to you.

Built in all sizes and types.

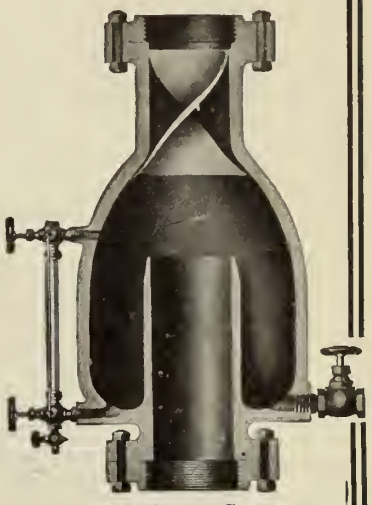
The "Swartwout" Steam Separator

Absolutely prevents all condensed steam from entering your engine, and is the only separator that does not create a back pressure.

Baffle plates or other obstructions are entirely absent—a feature not possessed by any other separator.

An investment that pays for itself in a few months.

Send for Catalogues.



Vertical Steam
Separator

The Standard Engineering Company, Limited

14-16 King Street East, - - - TORONTO

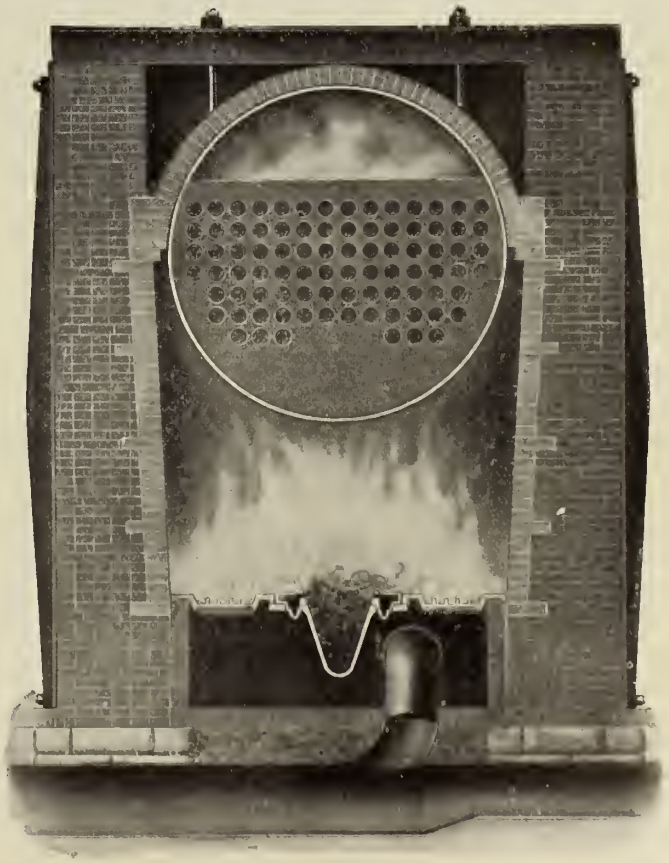
NO LOSSES

THERE are no grate bars in a Jones stoker, consequently NO LOSS of fuel through the bars.

The gases are driven off the coals and mixed with air ***beneath*** the fuel bed, pass through the fire, are brought up to the ignition temperature and consumed, consequently NO LOSS in unburned gases! NO SMOKE!

Utilizing the fuel with a minimum of loss, and with the automatic regulation of the steam pressure by the steam pressure itself, make a Jones Underfeed Stoker installation an ideal system of firing a steam boiler plant.

Let us tell you more about it.



Jones Underfeed Stoker Co., Limited

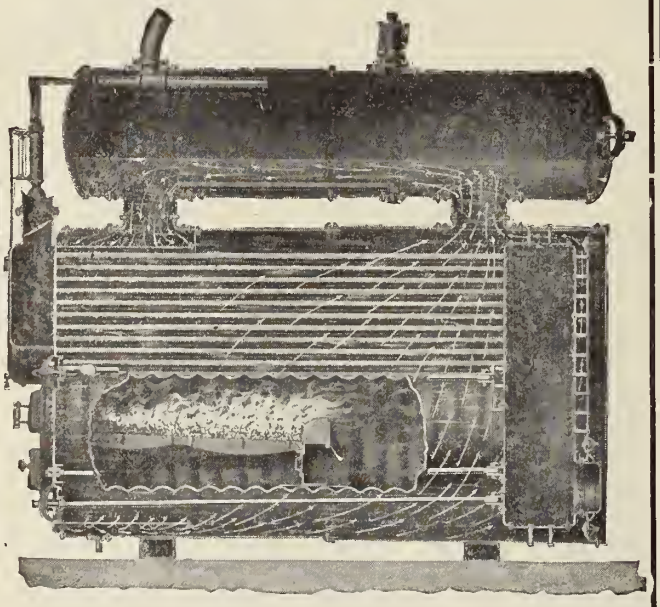
National Trust Building
TORONTO

Coristine Building
MONTREAL

Positive
Rapid
Circulation
in an
Internally-fired
Boiler
without pump or other device

The High Efficiency of the Scotch Marine Boiler is now available for plants ashore.

ROBB-BRADY SCOTCH BOILERS



Have all the desirable features of the Standard Marine type, but change the sluggish flow of water into rapid circulation by means of a steam drum and circulating passage under the front neck.

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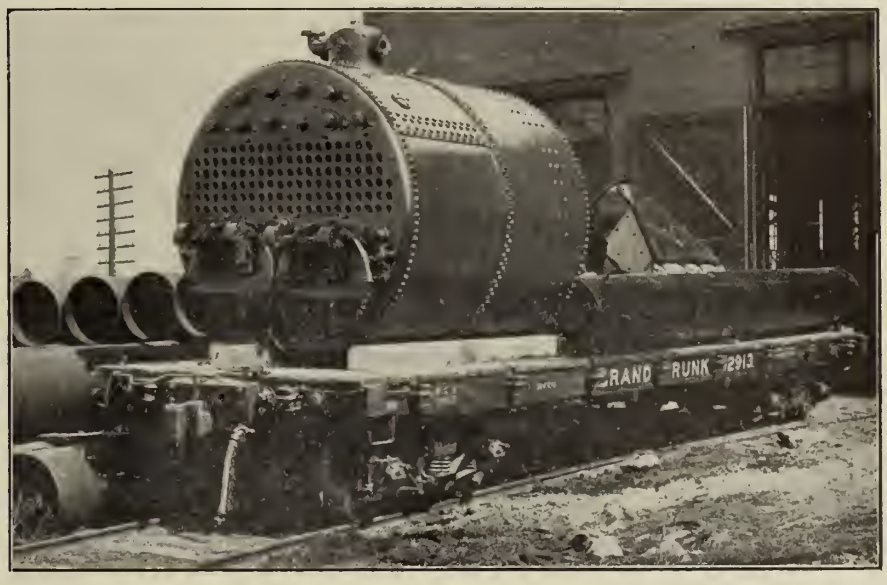

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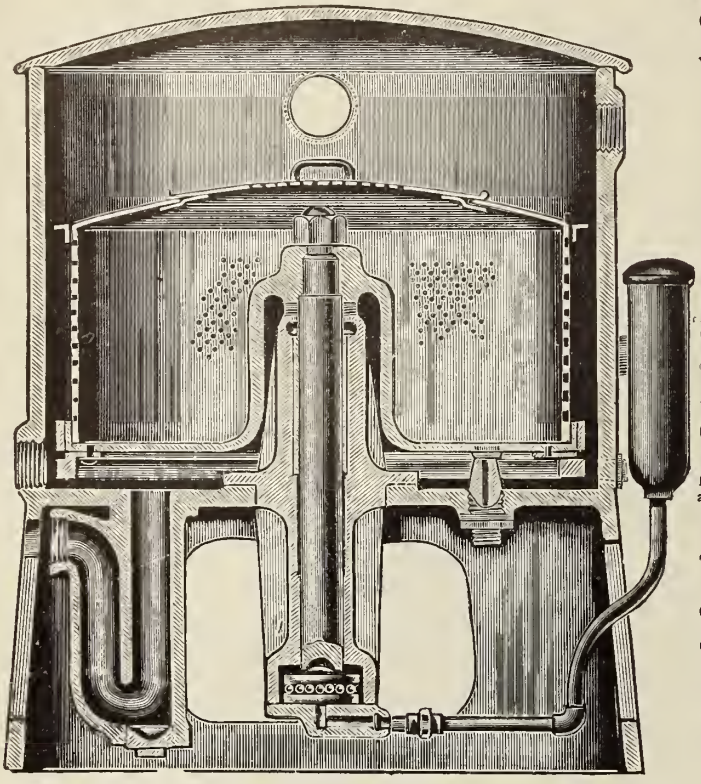

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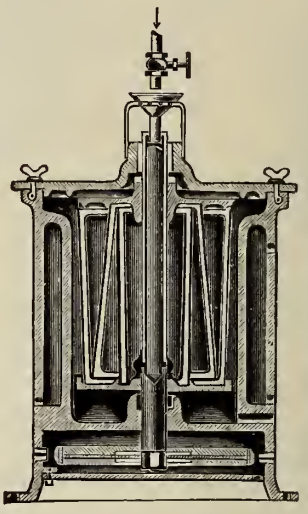

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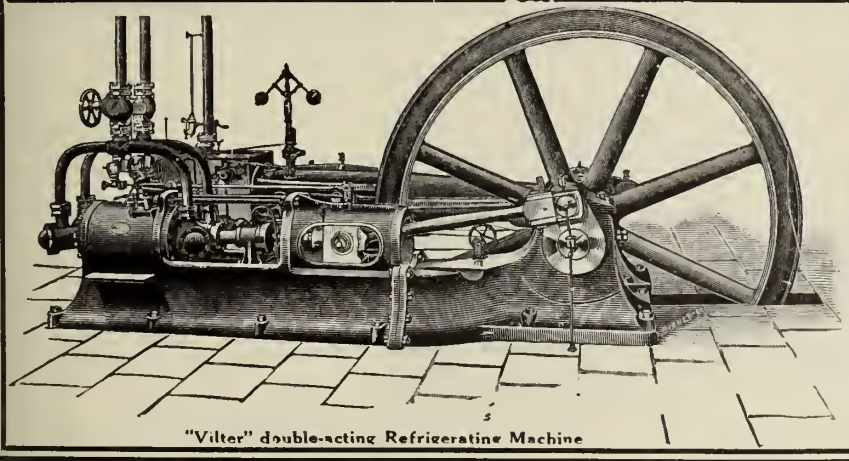

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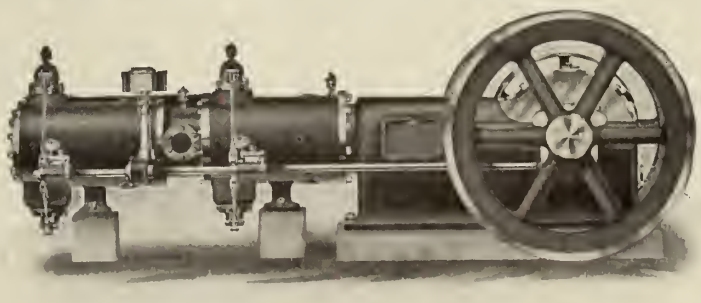

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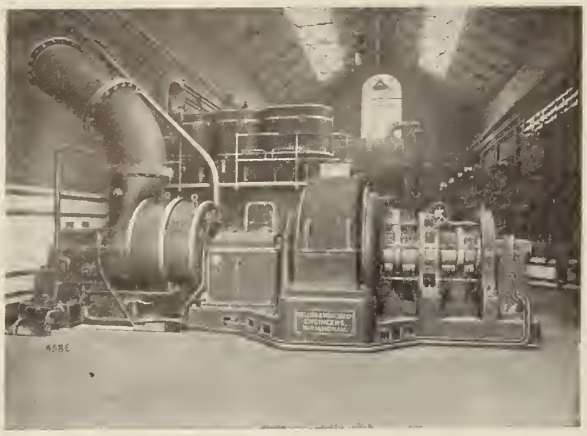

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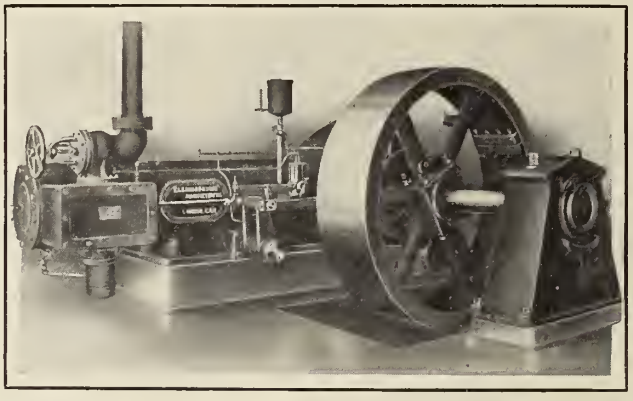

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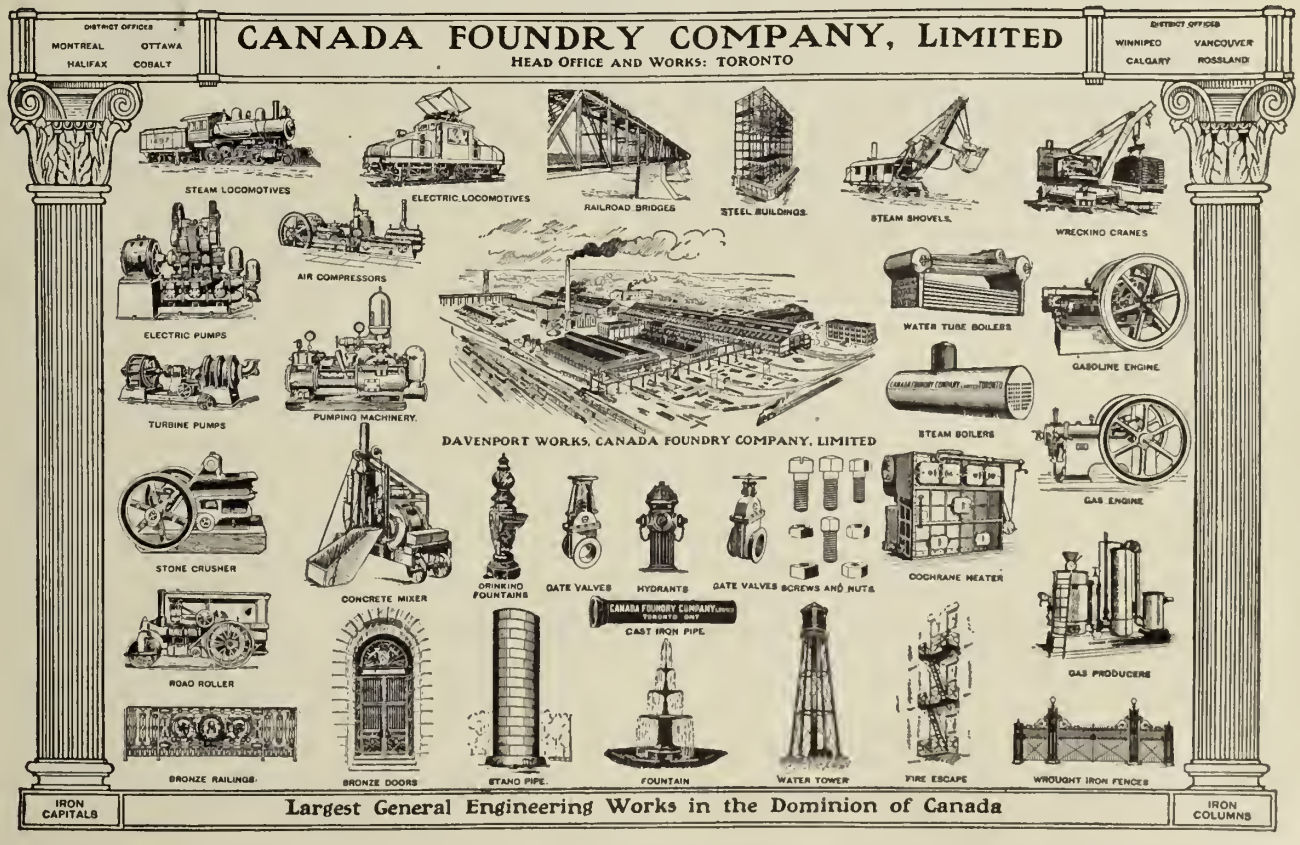

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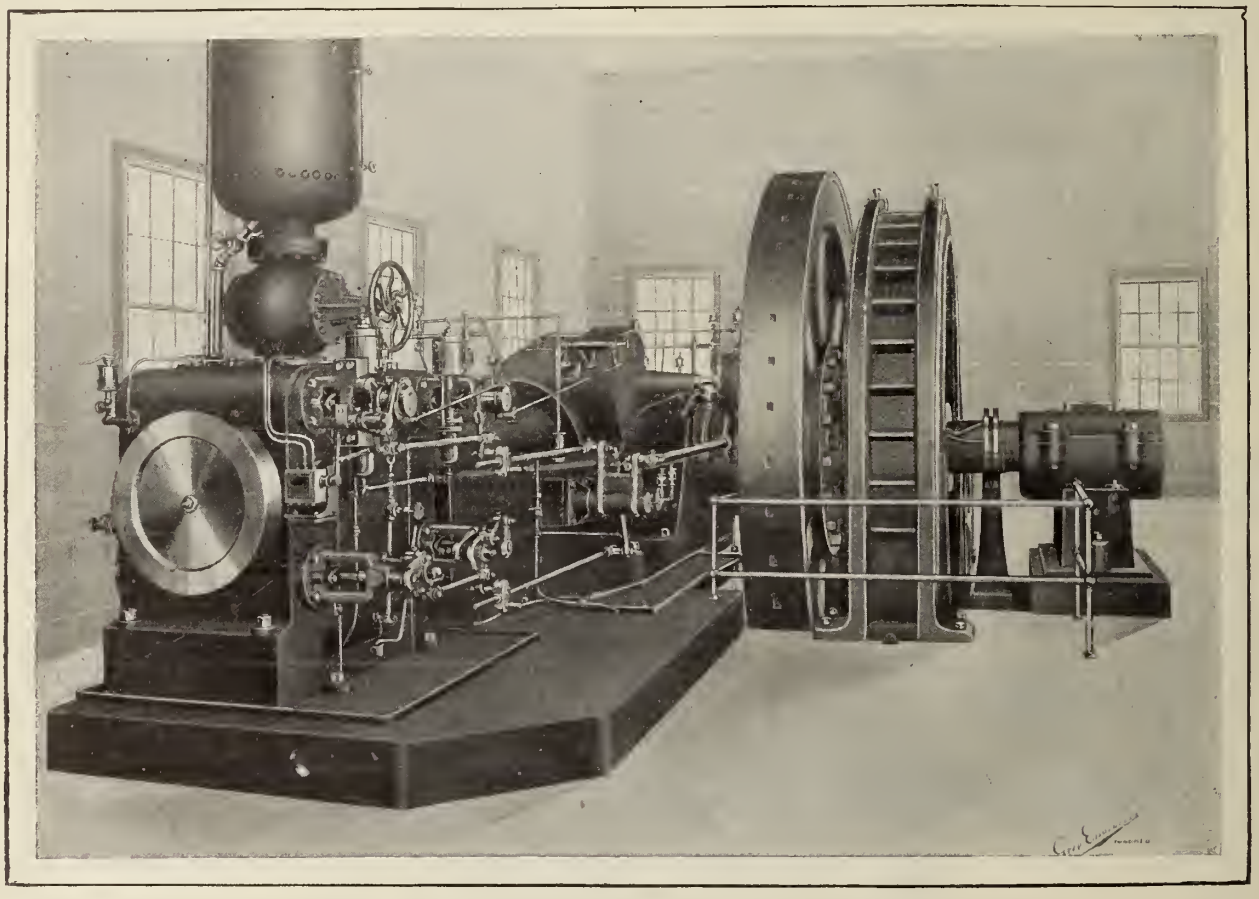

Illustration shows one of three Heavy Duty Simple Goldie Corliss Steam Engines, built and installed by us in the Power House of the Sandwich, Windsor & Amherstburg Street Railway, Windsor, Ont. These engines are economical in the consumption of coal, and you have the power just when you want it.

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The Municipal Lighting and Power Plant, Owen Sound, Ont.

By J. H. Williams*

There is shown in this descriptive article the birth and development of a well directed electric light and power enterprise, and coincident with it, the growth of a prominent manufacturing and Great Lakes seaport city.

THE progressive City of Owen Sound, Ont., has enjoyed the advantages of electric lighting for fully a quarter of a century. As long ago as 1886 a private concern organized, under the name of the Owen Sound Illuminating Co., proceeded to equip a steam plant to supply electric current for arc lighting purposes only. Apparently they did no very large volume of business, for in 1903, when the plant was taken over by the municipality, the total number of meters installed, both domestic and commercial, was only 36. The company's plant consisted of a Brown automatic engine of 150 h.p., which drove two d.c. generators, each having a capacity of 40-9-ampere arc lamps, wired in series The generators were of old-fashioned type and had an efficiency of not more than 60 per cent. Steam was supplied by one 60-inch by 16 ft. return tubular boiler.

After this steam-driven plant had been running eight years, the company installed a water power plant of 120 h.p. on the Sydenham river, about one mile outside the town. The two old generators were used and an additional one purchased. This last was a 133-cycle, 2-phase a.c. machine, with a capacity of 50 kw., and was bought with a view to supplying an incandescent lighting circuit, then being installed for the first time. Each year during the season of low water—from mid-June till October—the generators were disconnected from the turbines and brought back, one at a time, to the town and run from the Brown automatic engine. The water plant was in fairly successful operation for about 18 years.

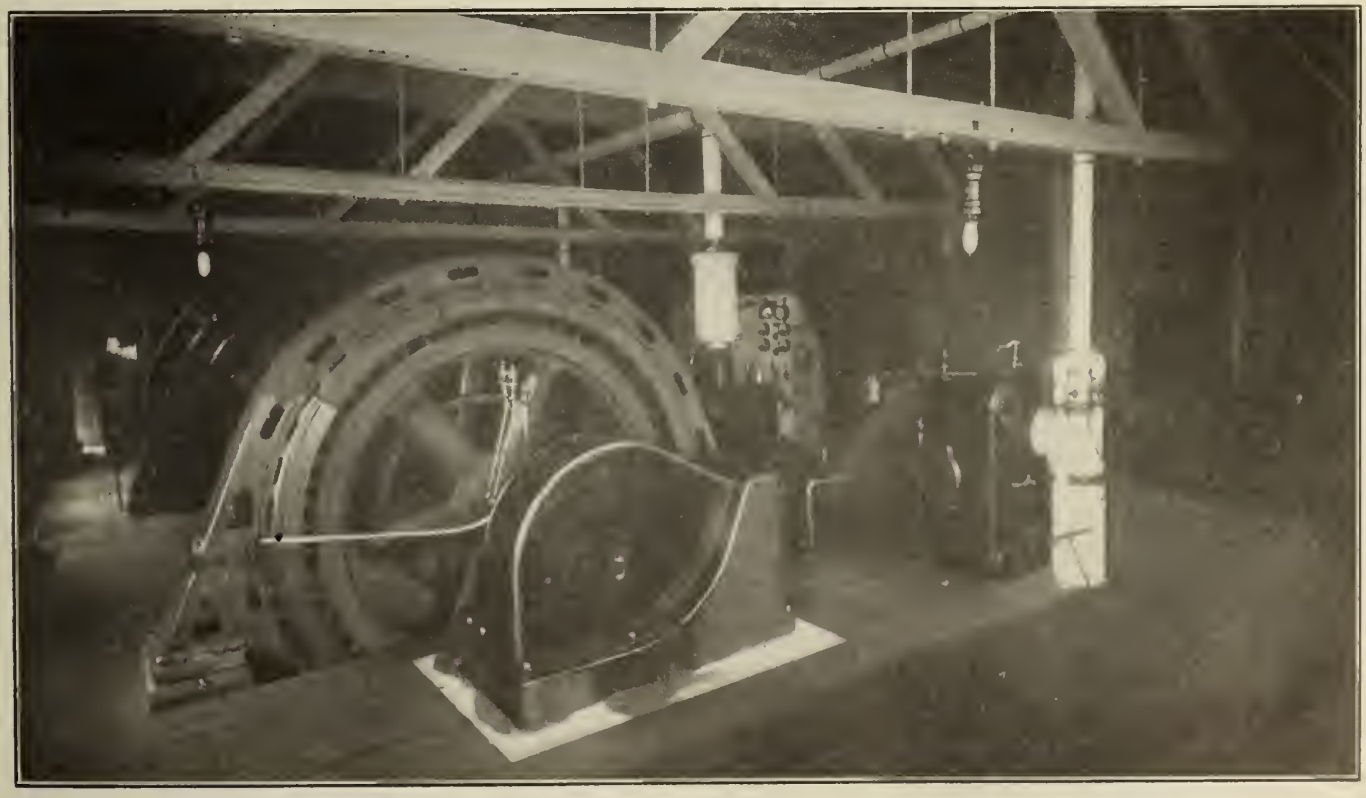
*Associate Editor, Toronto.

Municipal Operations.

In 1903, one year before the company's contract would have expired, an agreement was arrived at by which the town took over the plant, upon mutually satisfactory terms The municipal electricity department at once scrapped all the old power house equipment with the exception of the Brown engine, which continued to run until June, 1911. $10,000 was expended upon new electrical equipment, the principal items being two new a.c. generators. These were 3-phase, 60-cycle, 2200-volt machines, having a capacity of 78 kw. and 200 kw., respectively. They were both manufactured by the General Electric Co., of Sweden, and supplied through that company's Canadian agents, Kilmer, Pullen & Burnham, of Toronto. A number of Westinghouse enclosed series street lamps of 7 amperes, 100 kw. capacity, were purchased at the same time. From the above facts it will be seen that the town discontinued the d.c. supply and changed the frequency of the a.c. from 133 cycles to 60 cycles.

The Present Equipment.

From the beginning of its career the municipal plant supplied power as well as light, though much missionary work was required before manufacturers were fully persuaded of the advantages of the new system. However, by the end of 1906 the demand for current had increased to such an extent that the 78 kw. generator was replaced by another of the same make and type, but having a capacity of 425 kw. The 78 kw. machine had been driven by a turbine at the water power plant and was therefore not available during periods of low water, but as these, of course, correspond with the months of lowest load, no inconvenience was caused. With the new generator there was installed a Robb-Armstrong cross-compound con-



Owen Sound Lighting and Power Plant. General view of Engine Room with 425 k.w. Alternator and Robb-Armstrong Engine in the foreground

densing engine direct connected to the alternator. This engine has given most satisfactory results ever since it commenced running. Under a normal load, and with a vacuum of 24 inches, it will develop up to 625 h.p. at 128 r.p.m., on an extremely low coal consumption. The cylinders are 19 and 36 inches diameter by 30 inches stroke. Steam is condensed in an independent jet condenser supplied by the Goldie & McCulloch Co., Galt, Ont. The 200 kw. generator is driven by a tandem-compound Corliss condensing engine built by the John Inglis Co., Toronto. This engine replaced the Brown automatic in June, 1911. The latter had been in use for 25 years, during the last six or seven of which it had been very much overloaded.

Owen Sound Lighting and Power Plant. Boiler House.

The Inglis engine is direct connected to the generator and has cylinders 16 and 30 inches diameter by 36-inch stroke. The flywheel is 14 feet in diameter, weighs 15 tons, and makes 75 revolutions per minute, at which speed the engine develops 300 h.p. On its way from the high to the low-pressure cylinder the steam passes through a dryer, mounted directly above the two cylinders and heated by live steam. The low-pressure cylinder discharges to an independent jet condenser, also made by the John Inglis Co., the live steam from the dryer being also trapped to this condenser. The two engines run well in phase together, and although no detailed test has as yet been made of the Inglis unit, it is giving excellent satisfaction, and is expected to prove quite as economical as the other. The exciters for both units are belt-driven from the generator shafts, and are of the same make as the generators themselves.

The pump and condenser room is situated below the main engine room floor, the two condensers being immediately beneath their respective engines. Condensing water is taken from the Sydenham river, which runs alongside the plant at a distance of about 50 feet. The lift is only four feet, and is, of course, taken care of by the vacuum. There are at present two 8-5-10 duplex feed pumps, supplied by the Goldie & McCulloch Co. They take water from the hot well and deliver it to the boilers through a Robb closed heater, which raises the temperature to 195 or 200 deg. Fahr.

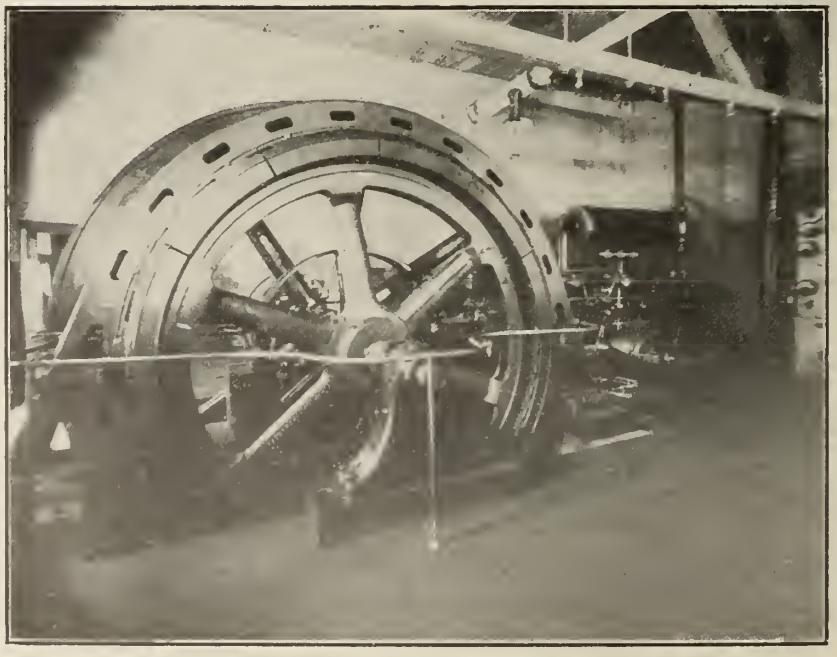
The Boiler House.

As may be seen from our illustration, there are three boilers, all hand-fired. Two are by the Goldie & McCulloch Co., Galt, and the third by the Jenckes Machine Co., Sherbrooke, Que. All are 72 inches diameter by 16 feet long and have 90 3½-inch tubes. The working pressure is 125 lbs. per square inch, and the coal consumption, taking the year round, averages about 40 tons per week of ¾ lump coal, costing $3.53 delivered to coal house. All three boilers are fitted with Turner automatic cleaners, the efficiency of which in dealing with very dirty water is the subject of high praise from the superintendent. A fourth boiler and a third feed pump are about to be put in, the steadily increasing load necessitating these additions. In fact, Owen Sound is developing so rapidly that it is probable that a third generator unit may have to be installed during this year, in which case the engine room will perhaps be enlarged.

The smoke stack is of hard red brick laid in half cement and half mortar. The foundation was excavated to a depth of 9 feet and 35 piles were driven, each being 35 feet long. On top of these a block of concrete 16 feet square was poured up to ground level. The stack is of octagonal shape outside for the first 25 feet up, after which it is circular. It is 90 inches in diameter outside at the top, and 72 inches inside, its total height being 120 feet. There are 70 incandescent lamps arranged in three rows around the top. These, lighted up during the summer season, are supported on a light framing which can be raised and lowered as required.

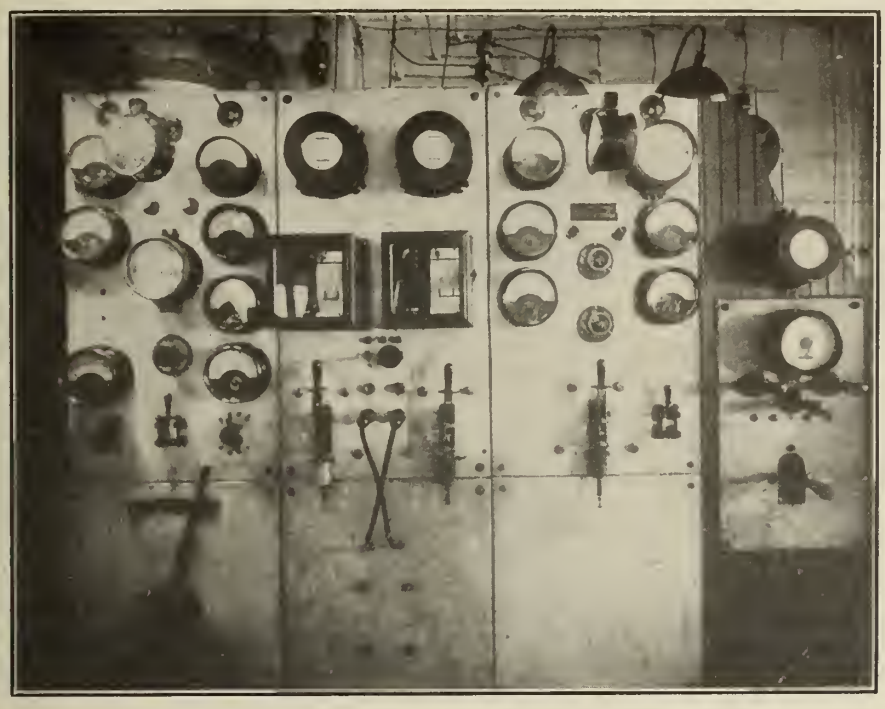
The Switch Board.

Returning to the engine room, the switchboard next claims attention. This is of white marble and was made by



Owen Sound Lighting and Power Plant. 200 k.w. Alternator and John Inglis Co. Engine.

the Swedish General Electric Co. It controls four separate circuits as follows: One lighting circuit of 2,200 volts potential for commercial lighting, stepped down to 110 volts by transformers on the consumers' premises; one power circuit of 2,200 volts for outskirts of the town, the voltage being stepped down by transformers on the street poles to



Owen Sound Lighting and Power Plant. Main Switch Board.

suit motors of 550 volts; one power circuit of 550 volts from the power house to nearby consumers, the potential being stepped down from 2,200 volts by static transformers located in the engine room, and one street lighting circuit. In addition to these, there is a second street lighting circuit controlled from an auxiliary switchboard not seen in any of our illustrations. The two circuits are controlled by a pair of constant current transformers with a capacity of 50 k.w. each for 7-ampere enclosed Westinghouse arc lamps. All power circuits are 3-phase and lighting circuits single-phase. All circuits are measured by integrating watt-meters located on the switchboard, so that a record may be kept of the cost of each, and thus ensure its being on a self-sustaining basis. There are also two curve drawing watt-meters, one for power and one for light. These are clearly seen in the illustration.

Progress Since 1903.

As an indication of the increase in current consumption, it may be mentioned that there are now 1,360 meters installed, as compared with 36 in 1903. No fewer than 380 of these were put in during the year 1911. There are now 30,000 lamps on the commercial lighting circuit, and 900 incandescent, together with 82 arc lamps on the street circuit. In 1911, motors totalling 460 h.p. were installed, and there are now on hand orders for an additional 70 h.p. Service installation is free, and meter rent 17 cents per month. Mention must be made of the novel method in which the incandescent lighting of the main street is carried out. The lamps are arranged across the street in the form of arches having a gentle rise. These arches are almost invisible by day, and as they are all at a uniform height and are equally spaced, the effect at night is very pleasing .

The electricity department, though owned by the town, is on an entirely self-sustaining basis. It provides its own sinking fund, and is paying off its own (20-year) debentures, besides maintaining itself generally. It receives from the town $60 per year for each arc lamp and $14 per year for each 32 c.p. incandescent lamp. Previous to November 1, 1911, these sums were $70 and $16 respectively. The present rates are: For light (all consumers) 8c per k.w., with 20 per cent. discount for prompt payment, and a further 20 per cent. on amounts over 100 k.w. per month. For power, 2c per k.w. up to 5 h.p. and 1¼c per k.w. for 5 h.p. and up, with an additional flat rate of $1 per month for each h.p. used. Previous to Nov. 1st, 1911, the lighting rate was 10c, instead of 8c, with the same discount as at present. During the ten months ending Oct. 31, 1911, there were generated 903,696 k.w., of which 411,869 k.w. were used for domestic and commercial lighting, and 320,033 k.w. for power purposes. The remainder gives the street lighting consumption. The department, during the ten months referred to, made a profit of $5,685.21 on commercial lighting and power, and $1,393.23 on street lighting. This was considered so satisfactory that the cuts already referred to were put into force.

The entire plant is under the superintendence of J. R. McLinden, who has under him a staff consisting of two engineers, two firemen and one coal passer, together with an outdoor staff of four linemen and one meter reader and trouble man.

THE LUNKENHEIMER CO. HONORED.

A DELEGATION representing the National Association of Stationary Engineers presented to the Lunkenheimer Company, on December 11th, an embossed testimonial, a reproduction of which is shown herewith. This was given in token of the appreciation of the members of the association for the river ride, picnic, barbecue and burgoo which was given by that company on September 13th last, during the convention of the N. A. S. E. held in Cincinnati. The testimonial was presented by Mr. F. W. Raven, the National Secretary, at a banquet given the delegation by The Lunkenheimer Company at the Cincinnati Business Men's Club. Mr. David C. Jones, secretary of the company, who acted as toastmaster, responded to the presentation speech made by Mr. Raven. Other speakers of the evening were: Mr. J. Kerley, chairman of the convention committee; Messrs. Delaney, Pratt, Schuler, Wilson, Boyer, Wermel, Thompson, Knopp, and Haber-

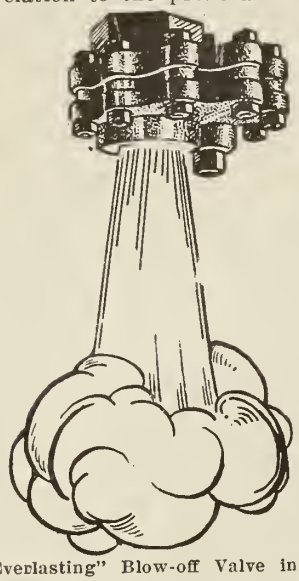
koppee, all members of the local convention committee, and Mr. H. E. Poole, of The Lunkenheimer Company.

This is only the second time in the history of the N. A. S. E. that a testimonial was presented, and naturally the Lunkenheimer Company feel highly honored and gratified.

THE BLOW-OFF VALVE.

By Calliope.

IS the blow-off valve of sufficient importance in the power house to warrant strict attention? Yes, it certainly is. A leak is waste, and waste is loss. All leaks are bad, although some are worse than others, and a leaky blow-off is one of the worst. It bears a very close relation to the profit and loss ac-



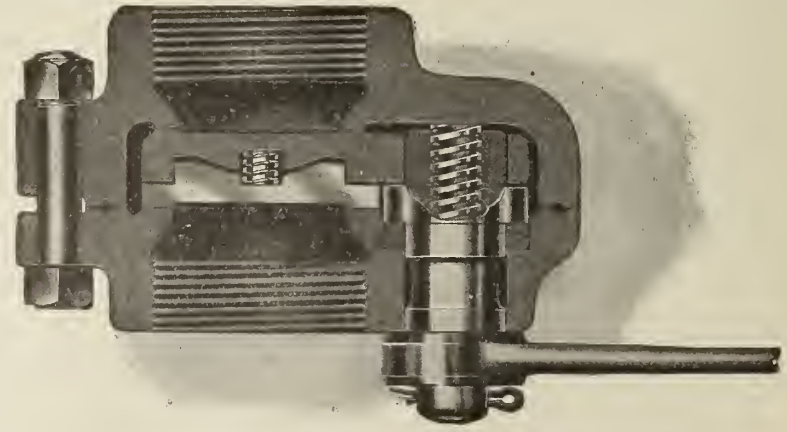
The "Everlasting" Blow-off Valve in Action.

count. A great many accountants do not know that a blow-off valve exists, and most of those who do know are under the impression that it is situated on the top of the boiler. Th equestion is: How much effect will a leaky blow-off valve have on the losses? It can be figured directly back to the coal pile, and the coal pile costs money. Coal saved is money added to the profits, and profit is what we are all after.

To Haswell we are indebted for the following information. To evaporate one pound of water, that is, to produce steam, 1,146 heat units are required. One Imperial gallon of water weighs ten pounds, therefore, it takes 1146×10= 11,460 heat units to evaporate one gallon of water. Now, assuming 6,000 units as the average economic value of coal, then 11,460 divided by 6,000 =1.9 lbs. of coal consumed to evaporate one gallon of water. Assuming that this is over-estimated, and the loss occasioned by one gallon of water leaking away, to be only one pound of coal, then a blow-off valve would not have to leak very badly to lose 5 gallons of water an hour, 120 gallons every 24 hours, and 3,600 gallons in thirty days, or a little over 1¾ tons of coal a month. This is approximately a loss of $8 per month, almost enough to pay for a good blow-off valve in one month's saving, and just that much more added to the profits for the other 11 months of the year.

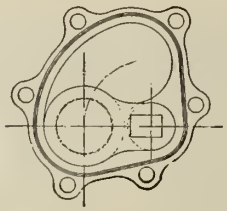
The blow-off valve is one of the loss producers or loss preventers, and just how much can only be determined by the size of the leak. The time to stop the leak is when it first starts, because every little dribble is costly. Did you ever try to maintain pressure in a small tank, with a leak in it, by means of a hand-presure pump? It is quite a strain on the muscles, and a drain on the energy of the man doing the pumping; yet there are a great many coal piles subject to as big a strain, on account of the blow-off valve leaking. You cannot always see the leak, but it's like the suit of clothes, in the traveler's expense account, there all the same. The blow-off valve as a waster is overlooked in a great many cases just for that reason, and one of the best methods of being sure of its effectiveness is to install a fitting made for the particular purpose. Money spent that way is money well spent.

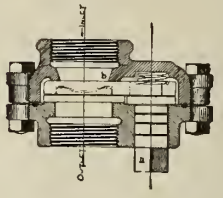
There are a number of good blow-off valves to be had, and one of the newest, and therefore, perhaps, worthy of special mention here on account of its design, is the Everlasting blow-off valve, recently put on the market by F. M. Patterson, at one time chief engineer of Cramp's shipyard. Mr. Patterson, in his design, has endeavored to prevent the possibility of the vital parts of the valve from coming in contact with the scale and sediment while blowing off. The valve, also, has a straight-through blow, and the orifice is of the same size and shape as the pipe. The disc never leaves the seat, thus doing away with the chance of particles lodging there and preventing the valve from properly seating itself when closed, as the disc in passing over the seat brushes off anything that may have lodged there. The valve has no stuffing box. The post or spindle is held back against a heavy pressure gasket by means of a strong coil spring, which also takes up any slight wear there may be, and assures a tight joint, without repacking.



The "Everlasting" Blow-off Valve—Sectional Detail.

This article is written with the object of pointing out the losses that are attendant upon the blow-off valve being allowed to leak, and the elimination of this contingency will be found worth the consideration of every steam boiler owner. Manufacturers of auxiliaries and accessories are more than keeping pace with the development and improvement of the main steam power plant units, and it is worthy of remark that special notice of this feature has been taken in every reference to the record power plant engineering progress of the past year.





The "Everlasting" Blow-off Valve—Sectional Detail.

LARGE RAILWAY LOCOMOTIVE.

One of the largest locomotives in the world has just been built for the Pennsylvania Railroad for freight service on the steep grades of the mountains in Western Pennsylvania. The engine, which is known as the H-H-1 type is 98ft. 3¾ in. long, including the tender. The total weight of the engine in working order and the tender loaded is 668,-900 lbs., or 238,900 lbs. heavier than the class K-2, the heaviest passenger engine, and 272,600 lbs. heavier than the class H-8-b, the heaviest freight engine used so far on the Pennsylvania Railroad. It is 644,275 lbs. heavier than the old John Bull. There are four cylinders, each having a diameter of 27 ins., and a stroke of 28 ins. There are 16-56 in. driving wheels. The steam pressure is 160 lbs., and the total heating surface amounts to 7,732.6 sq. ft., 3,103.7 ft. more than in the K-2 class. The inside dimensions of the fire box are 12 ft. by 8 ft. and the tender will hold 9,000 gallons of water and 30,000 lbs. of coal.

A NEW DEVELOPMENT IN STEAM TURBINES.

A NEW type of combined impulse and reaction turbine, christened the "Spiro", has been put on the market, and patents are pending in the United States, Canada, and Foreign Countries. It is of small size, and ranges in horse power from the smallest up to several hundred. The principle of its design and operation is seen at a glance from the two runners with herringbone teeth, fig. 1. The steam impinges in the central pocket formed by the juncture of the teeth.

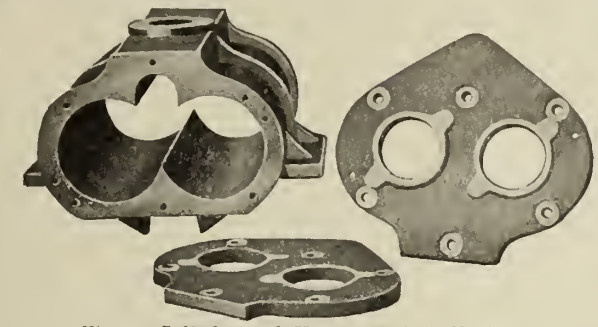


Fig. 3—Cylinder and Heads, "Spiro" Turbine.

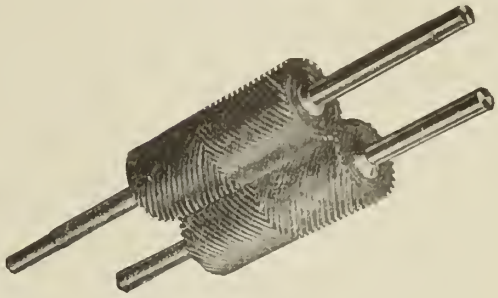


Fig. 1—Spiro Runners Mounted on Shaft.

Detail Features.

This turbine is the invention of John H. Van Deventer, superintendent of the Buffalo Forge Co., Buffalo, N.Y., and appears on the stage well out of its baby clothes, for three years of development and perfection already lie behind it. The construction of the turbine is extremely simple, consisting essentially of five parts :—the case, two heads with bearings, and two rotors. These rotors consist of helical gears, cut by special machinery, without loose or inserted blades. The steam action within the pockets formed by these spiral gear teeth, makes the largest possible use of the impact of the fluid due to its velocity.

The first impression of the "Spiro" is its extremely small size for a given power, as a unit of 185 horse power illustrates forcibly. This particular outfit has been in use for the last three years as the motive power in driving fans, gas scrubbers and other apparatus requiring a running test. It has neither been apart, nor had a single adjustment made upon it since installation. The stated power,—186 h.p., was developed under one hundred pounds initial pressure, and it has been decided to base the rating of all "Spiro" turbines on this. The "Spiro" is at present manufactured in sizes from one to fifty horsepower, non-condensing ; and arrangements are being made for an extension of sizes up to 300 h.p. It is believed that in many cases good use can be made of small turbines for auxiliary work, such as induced or forced draft, driving small pumps or centrifugal blowers, and other purposes. Fig. 3 shows a 10 horsepower "Spiro" direct connected to a 25 inch fan, which is at present furnishing forced draft through Jones Underfeed Stokers, to three 100 h.p. boilers.

There are but two points of wear in this turbine, the bearings and the tooth contact. The lubricating system is so designed that each bearing acts as an individual oil pump, circulating oil between the shaft and bushing with a positive pressure, thus forming a perfect oil film. The tooth contact of the helical gears ensures smooth running and strength well in excess of requirements. The length of the spiral rotors is greater than would be necessary for the face of spiral gears transmitting equal loads at equal speeds, and as a result, the maximum tooth pressure per square inch is a minimum. It has also been discovered that a film or cushion of steam is at all times maintained between the teeth, causing an elastic contact, sufficient to produce additional smoothness of action.

The Canadian Buffalo Forge Co., Montreal, Toronto, Winnipeg and Vancouver, are handling the Spiro turbine throughout the Dominion of Canada.

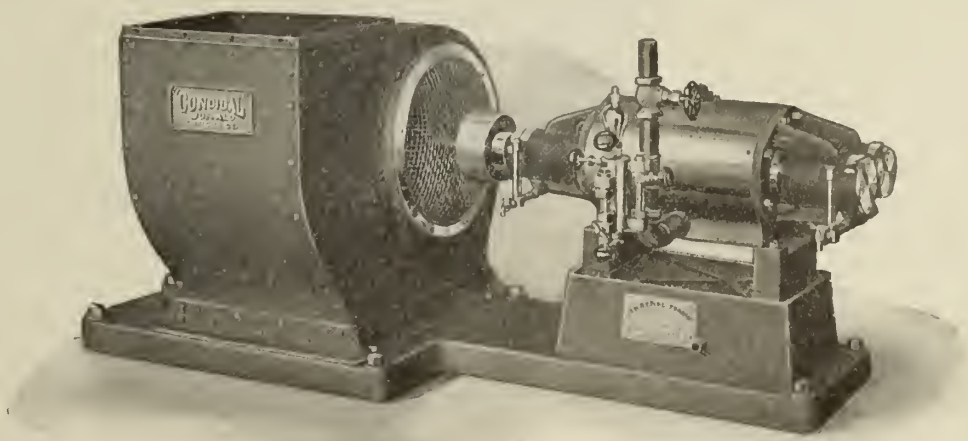


Fig. —10 h.p. "Spiro" Turbine and 25-inch Conoidal Fan for 300 Boiler horse power.

WOOD-BURNING PLANT FOR BRAZIL.

A pair of 300-h.p. gas engines to be served by a wood-burning producer have been built by Messrs. Mather & Platt for shipment to Brazil, where the plant is to be installed in a cotton-mill extension. Two single-cylinder, double-acting two-cycle engines drive on a countershaft, so arranged that the stoppage of one engine need not interfere with the working of the other set. About 300-h.p. is taken from the countershaft by the shafting of the mill extension and the other 300-h.p. by an electric alternator which supplies current for the motor-driven machinery of the dye-house. The wood-burning plant is adapted for ready conversion to coal consumption.

The Modern Steam Power Plant and Its Auxiliary Appliances*

By H. Kastella**

In his capacity of Chief Engineer of quite a modern and well equipped Power Plant, the writer of this paper is in a good position to speak of the many advantages to be derived from the exercise of a systematic operation of power plants in general. There is a highest economical efficiency attainable in every plant existent, and those in charge should make it their business to secure it.

MY subject is of direct personal interest to the owner and engineer of every power plant. The intention is, if possible, to awaken to a conscious realization, what is in a majority of cases an utterly careless and indifferent attitude to the engine and boiler rooms under their care. To some it may seem that there is not much involved, and that other and more pressing questions come forward for adjustment first. I want to ask you, "Are your engine and boiler rooms all they might be, all they should be, and do each of you realize that they are at present what you have made them?" A great many mistakes are made in laying out and building a steam power plant, not only from inexperience, but also from trying to reduce the first cost of installation. As you are all aware any apparatus or safety appliance can be installed far cheaper before the plant is in operation, than afterwards; and those safety appliances should be considered not only in large plants, but also in small ones.

The question arises, "Is it necessary when you are building a plant for yourself to have these safety appliances, or mechanical devices?" This question must be considered very carefully by the engineer in charge, also the owner of the plant. First of all, every plant cannot have the same mechanical devices, as nearly every plant is run under different conditions, and for different purposes. Another mistake made when installing a plant, is that you cannot do the work quickly enough for the company that is waiting to have it in operation. Sometimes you have not the material on hand that you should have, and many times you have to make a temporary job, to get started as early as possible. As many steam plants are running a twenty-four hours' service, you, therefore, have not the chance to change work improperly done in the first place. Operating a plant under the above mentioned conditions may be a great loss and disadvantage, financially and practically. Again, if you want to make any change, it means shutting down for a certain length of time, and sometimes much longer than expected. This involves another loss which may run to large figures.

*Abstract of paper read before the Central Railway Club, Toronto.

**Chief Engineer, the G. T. R. shops power plant, Stratford, Ont.

Order and Economy.

It is not necessary that tiled floors and white enamcled brick walls, should be part of a power plant equipment, but it is necessary that every engineer should see that the plant, of which he has charge, is kept in such a manner that it does not reflect injuriously on him. Boiler rooms generally suffer more than engine rooms, due largely to a poor layout in the matter of access and light for inspection, and being thus under a

A. KASTELLA.

cloud as it were, do not draw attention or criticism to the same extent. Not enough interest is taken in them by engineers, in fact their absence is marked. This should not be allowed, as this is after all the important part of the plant.

We will go a little farther into the economy question. When a large manufacturing company is building a new factory, the first question, generally, is that of power. How can they buy or generate power, so as to compete with other manufacturers. It would take too much time and space, were I to take this feature up in detail from the smallest to the largest power plant. It is well known that the larger the plant the cheaper the power generated. However, in some cases, from 15 to 40 per cent. increased efficiency could be derived from the majority of small plants by proper installation, care and attention.

Auxiliary Apparatus.

We have a number of stokers on the market, and from practical experience, I think we find that the highest efficiency in regard to firing is obtained from automatic stoking. At the Grand Trunk shops power plant, Stratford, we are equipped with four chain-grate stokers. Each has a grate area of 72 square feet. I, personally, consider this stoker one of the greatest labor savers on the market to-day, under normal conditions. Suppose, however, this automatic stoker, with a grate surface of 72 square feet, and the amount of coal that you can burn per square foot, say eighteen pounds, to have to meet a demand for more steam, and you have to increase the feed of your coal, say from eighteen to twenty-eight pounds per square foot, is it possible to get the same efficiency, not only from your coal, but also from your boilers, when you are over-rating both stokers and boilers. You have to travel the stoker at a greater speed, and the result will be that a large amount of combustible will run down to the ash pits, your combustion chambers will not be large enough to effect combustion of the extra amount of coal, the flue gases increase, and the result is, that your efficiency is escaping through the chimney.

To be equipped with alarm water columns for low and high water is a great advantage, especially for small power plants. In most of the new power plants, small or large, the man in charge may depend on this alarm to warn him.

It is very good policy for a steam plant to have a recording steam pressure gauge connected with the water column, as it will record every time that the man in charge blows down the water column, and these men will be more careful, as the recording pressure cards have to be sent daily to the office, to show if the man on his shift attended to his duties or not. The man who examines the recording pressure gauge cards should pay close attention and see that the water columns are blown down at least twice daily.

Another very important thing in re-

gard to boiler equipment is the pumps or other devices for feeding the boilers with water. In a great many power plants you cannot find more than one pump for this purpose. This is a very great mistake. Every engineer knows that if his boiler feed pump fails, the whole plant has to be shut down to prevent a boiler explosion or other damage due to running too long with low water in the boilers, when trying to get the pump in operation without shutting down. For this reason, not only every engineer, but also every plant owner should insist upon having a duplicate set of pumps, or other devices for feeding water to the steam boilers.

Furnace Economical Efficiency.

This subject is one, which may be expanded almost indefinitely, and which involves a consideration of all the requirements of modern stoking, and the inability of the individual to divide his attention, and obtain the same result as when his attention is concentrated. In other words it involves not only the preliminary of machine efficiency, but involves the question of human reliability and human weakness. I desire, therefore, to set forth the relation between furnace efficiency and the usual practice in boiler room management.

It is a well-known fact, and one from which the plant owner continually suffers, that it is extremely difficult to get the same efficiency from a number of units in service simultaneously, that may be developed when one unit is under test. The engineer in charge will usually proceed by taking some one unit and fitting it with the necessary pump and measuring apparatus for conducting a boiler trial or test. He will find perhaps, that his furnace is not developing the efficiency to be expected. The results of his preliminary run will indicate perhaps too high a percentage of free oxygen in the gases, too large an amount of C.O. or too high a temperature of flue gases. The next step will be to remodel the furnace, change the type of grate surface, add to his height of chimney, increase his combustion arches, or in other ways seek to provide more satisfactory conditions for the development of these results which he knows he requires. Herein lies the first test of the engineer's ability, and no one can prescribe more than general rules for the perfecting of his boiler units.

A reiteration of the essentials for furnace efficiency need not now be set forth in detail, as they are common property, and have been rehearsed so often that they are practically universally known. The exact means, however, that must be used to secure the desired result, is an entirely different problem, although if the engineer has the ability to properly measure and co-ordinate the existing conditions, the remedies are usually comparatively obvious. Commercial considerations render it practicable to provide a furnace theoretically prefect. We have, therefore to consider a certain efficiency as the maximum practical efficiency that may commercially be obtained, and this is expressed in terms of the furnace, substantially as follows:

(1). It is not possible to burn bituminous coal with much less than 50 per cent. excess of air, or in the neighborhood of eighteen pounds of air per pound of coal.

(2). It is not commercially possible to burn more than 99 per cent. of bituminous coal fed to the furnace.

(3). It is not commercially possible to extract so much heat from the escaping gases that their temperature shall be less than the temperature of the steam at the given boiler pressure. These three primary considerations should be first taken into account by the engineer in his analysis of furnace efficiency. The exact methods to be employed by him in determining the means for accomplishing the desired results cannot be herein prescribed, as they differ with every design of boiler furnaces and grate surface. That different boilers have different heat absorbing powers is unquestioned, and that different grate surfaces have different capabilities of retaining fuel under combustion is also unquestioned, and that there are different capacities for holding the gases of combustion is perhaps the most obvious of all. It should, however, be the aim of the engineer to secure not less than 10 per cent. of CO_2 in the flue gases. This may be accomplished by stopping all air leaks around the setting of the grate surface, by keeping a uniform fuel bed without holes or leaks, by carrying a fuel bed of sufficient thickness that extreme porosity is avoided, and by not opening the furnace doors more than the necessary minimum. If all the air entering the furnace is compelled to pass through the bed of burning fuel in order to enter the furnace, satisfactory results must almost necessarily follow. It is the unauthorized air leakages that do the damage, and these must be eliminated. All the heat carried away in the escaping gases is lost, and it is obvious that this amount must be reduced to a minimum. Economizers will actually economize, provided the resistance to the flow of the gases offered throughout does not cause greater loss by causing decreased efficiency in the furnace and increased waste in the ash pit. Not only must the temperature of the escaping gases be considered, but adequate furnace draught must be attained, or you will lose from one more than you will gain from the other.

Flue gases cannot be reduced in temperature below 425 degrees F., and a working temperature of 500 degrees to 550 degrees is usually considered as satisfactory as it is practical to obtain. Any increase of this temperature may mean either a short circuiting of the gases of the boiler, due to defective baffles, excessive velocity of gases in the boiler setting, or air leakage at or near the furnace. It may be due also to defective heat absorbing power of the boiler, the result of scale or soot inside or outside of the tubes. It is safe to say, therefore, that any temperature over 550 degrees in the flue should at once cause an investigation, that the absorption may be increased and the waste at this point decreased. With one unit in a satisfactory condition of efficiency, the next problem is to extend this efficiency throughout the boiler room, and operate a number of units in such a manner that the over all results may be as nearly as possible equal to the individual. This is a question which involves the ability of the operator to divide his attention, and is very largely a question of discipline in the boiler room

It frequently happens that there is 10 or 15 per cent. less efficiency when the entire plant is considered, than is shown in a single boiler test, so it becomes very important that the management should establish such routine and system as will offset the negligence, carelessness or inability of the fireman.

Efficiency Test Method.

Perhaps the most satisfactory method is that of continuous test, which is one of original equipment and systematic operation. In this system each furnace is supplied with coal, which passes through a weighing tank, so that the exact amount burned in every furnace is made a matter of daily record. The entire plant is equipped with recording Venturi meters, and if possible each unit is supplied with an indicating Venturi meter in the auxiliary feed line. Daily records of the recording meter are kept up, and by means of the individual indicating meters, the water consumption of a particular unit may be checked at any time. Attached to each boiler is a Hay's gas sampling tank, which may be adjusted to withdraw a sample of the flue gases for any period desired. The station is equipped with the gas analysis instrument, by which the engineer may analyze his various gas samples daily, or on each shift. This result should be posted in the boiler room, with the name of the fireman indicated thereon, and any fireman not developing the required quality of gas is in line for some private

instruction. A daily sample of the ash from each boiler is taken and analyzed for combustible. This result is also posted in the boiler room the following day with the number of the boiler and the fireman in charge thereof. It will be found that competition between various firemen or various shifts will be immediately established, and the tone of the entire boiler room will be improved almost automatically. If it does not have this result, the chief engineer has the information at hand that will enable him to apply the pressure in the right place.

All of this might seem like an unnecessary expense, and an impracticable proposition, but in a plant containing many boilers, it is economy of a proper and essential kind. When the waste of heat up the stack and into the pit is measured in dollars and cents, there will be no question as to the saving to be effected by the above procedure, and all that is necessary to convince the skeptic is to figure whot it would cost to do this, and what it would cost not to do it. The above system supplies the essentials for a continuous test, and the engineer in charge can daily check up his operations, placing the blame for low efficiency where it belongs, and thereby be equipped with the information necessary for the immediate elimination of the waste.

As in other matters, eternal vigilance is the price of economy, and to paraphrase a well-known author,—"The descent into inefficiency is easy."

Automatic Steam Regulation.

The economy of automatic steam regulation in a boiler plant is of sufficient importance to warrant any manager or superintendent taking the time necessary to investigate it. It is practically impossible for the fireman to maintain steam at an exact pressure without mechanical aids. The varying load of an engine, caused by the throwing on or off of the various machines throughout the plant, or the different amount of work which these machines are required to do, affect the amount of steam used by the engine. The fireman has no means of knowing when the load is going to be light or heavy, the best he can do is to keep the steam at about the required pressure. If the load, or in other words the amount of work which the engine is doing, should increase for a while, or be kept at full capacity, the fireman would keep a hot fire under the boiler in order to generate steam enough to keep the engine turning at its correct speed Should the work on the machines slacken, which it will do for any one of a number of reasons, such action would lighten the load on the engine, causing it to take less steam, while the fire under the boiler would keep on generating steam, for which there was no use. As a result the steam would rise, and the safety valves release the pressure, thus allowing the excess to escape to the air. This, of course, is a waste of steam, water, coal and labor, and money to the owner, which may be prevented by a proper damper regulator.

The damper regulator acts on the boiler just as the governor acts on the engine, and no one would think of asking the engineer to stand by the controlling valve of his engine in order to regulate the amount of steam it should have to keep the revolutions of a line shaft at the proper speed to produce the necessary amount of work throughout the factory. When the steam drops below the required pressure only a few pounds, the governor will keep the engine turning at the same speed but it will be by the admission of more steam to the cylinder. To maintain the engine speed the steam consumed is increased in two ways, first, by its expansive power as the pressure is reduced. The higher the pressure the drier the steam will be, causing quicker action and more expansive force, thereby doing more work with a less volume of steam. When the steam is low the engine takes more of it to do the same work. This means that more water has to be evaporated, that more water has to be pumped or injected into the boiler, which also requires more steam, all of which means that more fuel has to be burned in order to evaporate the extra water required to make the extra steam.

If when the steam is low, the full load is put on the engine by the operation of all the machines in a plant, or an extra load on some of them, the machinery throughout the entire plant will drag, and the production of that day will be less than normal. This condition may be prevented by an automatic-damper regulator. When the steam reaches the given pressure it closes the upper, or back damper. By closing this, the heat arising from the grate is held in the tubes and around the boiler, so that the damper may be shut longer, and the steam pressure remain up longer, without burning more fuel than would be burned when the fireman closes the ash pit doors, allowing the heat to be free to pass on to the stack. The latter method is resorted to when no regulator is used When the upper or stack damper is closed, the air is entirely prevented from passing through the coal. Coal will not burn unless supplied with air. This leaves the coal lying on the grates, but not burning, ready the instant the damper opens to start generating more steam, thus keeping a more even heat on the boiler and tubes and preventing the contraction and expansion, which causes so many leaky tubes. When the damper is used, the ash pit doors remain open to allow the air to circulate under the grate bars, thereby keeping them in better shape and making them last longer.

Where there are automatic stokers under the boilers, the damper regulator is connected with the stoker engines as well as witth the damper. When the damper closes, the stokers are slowed down so that the supply of fuel is checked until the damper opens again, and more fuel is needed This is accomplished either by a mechanical connection to a quick opening valve or by a water connection between the regulator cylinder and a pressure regulator on the stoker engine supply line. When burning gas or oil as fuel, an extra quick opening valve is used on the burner supply pipe, and the regulator opens and closes this valve as well as the damper. This cuts off the supply of gas or oil and insures a positive saving.

Engine Efficiency.

The efficiency of the steam engine is often based on the amount of fuel burned per indicated horse power per hour, but is more properly based on steam consumption. The highest class of steam engines running condensing will use under test conditions from 12 to 12½ pounds of water in the form of steam per indicated horse power per hour while the ordinary automatic cut-off engine, with single expansion, non-condensing, uses from twenty-eight to thirty-five pounds. The fuel used per horse power per hour, therefore, depends on the quality of coal and the efficiency of the boiler and furnace, as well as upon the efficiency of the engine. A good boiler, properly set and fired, will show a much higher efficiency per cent. than the engine. When operated with high grade coal and under the best of conditions, a boiler may deliver to the engine as much as 75 per cent. of the theoretical heat of the coal, and if the coal contain 14,500 b.t.u. per pound, this is equivalent to 9.78 pounds of water evaporated from a feed water temperature of 120 degrees to steam at 200 pounds gauge pressure. If the engine uses 12 pounds of steam per horse power, this means a coal consumption of 1.23 pounds per indicated horse power per hour, or if the engine uses 30 pounds of steam, a coal consumption of 3.07 pounds. These figures, if transposed, for efficiency would be about as follows: one pound of coal having 14,500 b.t.u. is equivalent to 11,281,000 foot pounds, which on a supposition of 75 per cent. efficiency in the boiler, is equal to 8,450,750 foot pounds, which, if all were

utilized by the engine, would produce 4.29 horse power for one hour, or at the rate of .233 pounds of coal per horse power per hour, instead of the amounts above stated.

On this basis, the highest class engine has an efficieney of seareely 19 per cent., and the other of a little more than 7½ per cent. It is economy, therefore, in most cases to use a high class engine. There are instances, however, where the engine is used for so short a time in each year, that the saving may not be sufficient to pay the interest on the additional cost, and a cheaper engine, even if comparatively wasteful, may be better economy. Compound engines, when high pressure can be obtained, have an advantage in eeonomy over single eylinders, and triple and quadruple expansion engines show a saving over simple compound, but they require a pressure of 150 to 200 pounds, and a comparatively steady load to devlop their advantage to a great degree.

The Engine Power.

A large boiler is generally an advantage, but it is not economy to use a large engine to develop small power. When seleeting an engine for any particular plant, the first thing to decide is the amount of power required. If an engine is already installed, and the new engine is only a replacement, this is an easy matter, as indicator cards may be taken from the engine to be replaced. If the power house is an entirely new one, then a list of the machinery to be driven will have to be made out, and the total power determined from the amount taken to drive each one individually. Great eare should be taken when figuring out the power to take into aceount the length of time, and also the particular time of day, during which each machine will run, as this has a great bearing on the determination of the proper size of engine. When the list of powers and time of running of each machine is fixed, a power curve should be laid out, showing the variation in load during the twenty-four hours or portion of it, which eonstitutes the daily run. The power eurve will give the minimum average, maximum, or peak loads, and an examination will tell whether it is best to develop the power with one unit, or divide it between two or more units.

When the power to be developed has been decided, it is then necessary to examine the running conditions of the plant. The first thing to find out is the steam pressure available, and whether the steam is superheated, and if so, the degree of superheat, also whether the engine is to run condensing or non-condensing, and if the latter, the amount of back pressure. If there is an exhaust steam heating system in connection with the plant, the amount of exhaust steam needed, and the number of months in the year it is in operation, will have to be determined. When this information has been collected, it will be seen how much steam economy will effect the selection, for if the heating system takes as much or more steam as does the engine to develop the power required, the steam economy is not of such importance as it otherwise might be, although in the majority of plants, in this country, of any size, the element of steam eeonomy enters largely into the problem, by reason of the faet that the steam required for power is largely in excess of that required for heating, and that the heating plant is shut down for about half the year. This being the case it is necessary for the engineer to determine the most economical engine for his purpose. His choice will be somewhat influenced by price, but in the long run it pays best to buy a well-made engine, built by a reputable firm, and one that is eeonomieal in the use of steam.

Any good firm of engine builders will will give a guaranteed steam performance of their engine, but this guarantee should be carefully examined to see that the guaranteed performance is under the same conditions that the engine is to run. Particularly should this be done where the engine is to run on saturated steam, as many engines which are built especially to run with superheated steam and give good results under these conditions, fall down badly when running on ordinary saturated steam.

For all-round economy and reliability, the four valve or Corliss type, as now built by the best makers, will always hold first place, but the purchase of a cheap type of this engine should be avoided, as it is only by careful work in connection with the wearing parts, and such machine work as will ensure tight pistons and valves that low steam consumption is obtained The cost of keeping up repairs on this type of engine has often been used as an argument against it, but an examination of the records will show an astonishing number of engines that have been running for years without a cent's worth of repairs.

At the Stratford Grand Trunk shops we have two Corliss cross-compound non-condensing engines running under 150 pounds steam pressure, and at 150 r.p.m. These engines have been in operation for three years, running on an average eighteen hours a day, and I personally eonsider these engines as good to-day as when we received them, and up to this date we have not spent a single cent on them for repairs.

The Exhaust Steam Turbine.

The problem of increasing the capacity of an existing power house, which is already crowded for room, has been successfully solved by the advent of the exhaust steam or low pressure turbine. The chief reason for the rapid growth in favor of the low pressure turbine, is the fact that the steam turbine is much more economical in the low pressure stages than a reciprocating engine, it being capable of producing a horse power on or about 30 pounds of steam at atmosphere pressure and 28 inches of vacuum. It will thus be seen that if we have an engine that develops a horse power on 15 pounds of steam when running condensing, and 20 pounds when running non-condensing, and put the steam in a low pressure turbine, we would have, (allowing 5 pounds per horse power hour for condensation in the cylinders) 15 pounds left to put into the turbine, and there develop ½ horse power, or altogether 1½ horse power, with our original 20 pounds of steam for the combined engine and turbine. This will give a rough idea of where the gain comes by using an exhaust steam turbine. It not only increases the capacity of the plant 50 per cent., but decreases the steam consumption per horse power 16½ per cent.

To every engineer who is operating a steam plant, I would say,—give your engine and boiler room your best and most careful attention, show administrative ability, and then you will get the best efficiency possible from a steam plant such as yours may be.

QUEBEC WATER POWERS.

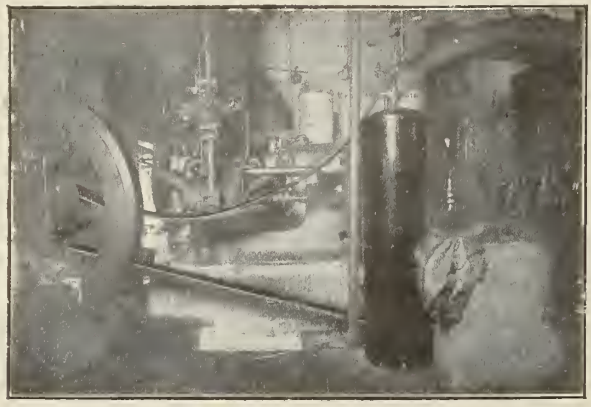
The Department of Lands and Forests of Quebec has issued a pamphlet descriptive of water powers to be offered at public auction at Quebec, on May 14th, 1912. Fifteen powers are included in the list, the possible theoretical power varying from 130 to 14,000 horse power and the minimum to be developed and paid for, varying from 65 to 7,000 h.p. The grants are to be made under what is known as "emphyteutic" lease for seventy-five years "but without guarantee from the Crown as to the existence of its rights on the water powers and the river beds thus conceded." The successful bidders will be required within a stated time to develop a minimum stated power and in addition to the auction rental price, will be required to pay a royalty per horse power, of from ten to fifteen cents according to the situation and availability of the power.

The more tin a steam-metal mixture contains, the better it casts. When too little tin is present, the casting shrinks excessively.

MODERN BELT METHODS.

By C. T. R.

TRANSMISSION of power through shafting under favorable conditions is more efficient than is generally supposed. Much depends upon the care exercised in hanging the shafting, the arrangements of the pulleys, and more important still, the tension of the belts. In Prof. Goodman's text book, "Mechanics Applied to Engineering," it is shown that if properly lined-up, a solid shaft with ordinary bearings would transmit power a distance of 6,000 feet with an efficiency of 80 per cent., when all forces are purely torsional. With belts, in which bending and torsion are necessarily combined, that distance drops to 400 feet. Still, 400 feet is a much greater distance than is accomplished by shafting under ordinary conditions with an efficiency of 80 per cent. Three-fourths of the latter is high. An allowance of 30 per cent. loss of power in the shafting of many modern machine shops is not uncommon.



Cut showing belt drive carefully and properl y treated.

Belt Tension.

It is not difficult to show how these losses may in large measure be prevented. If, without belts, power can be transmitted 12.5 times farther than with belts, and with the same efficiency, it will surely pay to give your belts serious consideration and attention. In the old days it was thought that to insure best belt transmission the belt tensions must be high. Engineers can be found to-day who still think so, and they will back their arguments with intricate formulae, in which tensions are shown as important factors. The fact is, no satisfactory belt formula has yet been derived, because conditions are so variable. It is best to follow precedent, but not precedent of the "old days." Recently established methods that are dependable should always be given first consideration.

Many belt drives are arranged with only one hanger to give rigidity to the driven pulley. The enormous tensions in a tight belt are sufficient to deflect the shafting considerably. In practice the deflection is not as marked as is shown here, but the slightest deflection serious affects the transmission efficiency, as Prof, Goodman forcibly indicates. In operation, the shafting maintains that form, and the friction, both internal and in the bearings, increases with the amount of deflection It is necessary then to reduce the belt tensions as much as possible, and the only way to do this effectively is to properly treat the belt. Assuming that belt tensions are necessary, but knowing that in operation one side can run slack or easy, let us suppose a tension of 200 pounds is needed by a belt according to the formulae used by some engineers. Suppose, also, that tension is nicely adjusted some day when the thermometer registers 70 deg. Fahr., and the humidity is low. The belt drives satisfactorily on that day, that is, it does not slip. Next day the temperature rises and the humidity increases. Both are factors that lengthen nearly all belts; in fact, all belts composed of vegetable substance, with the possible exception of rubber. This destroys the fine adjustment made on the previous day. The belt treatment is imperfect, and the belt slips. In any case, if the weather conditions hadn't changed, the belt would have stretched slowly, and a new adjustment would soon have to be made anyway.

Belt Stretch and Slippage.

In tropical regions, some belts have been known to change length six inches in one day for the reasons just mentioned. Humidity is the principal cause of trouble when the belts are not waterproof. Where slight initial tension is needed, the belt must therefore be waterproof to give the best results. It is not necessary to buy rubber or special waterproof belts for drives where an ordinary leather belt is preferable. Ordinary leather belts can be made practically immune to damp or steamy surroundings or to the actual slopping of water on them by proper treatment application. The belt efficiency is increased because the bending qualities of the belt are improved, the belt is made flexible and slipping is prevented.

Since leather belts are made up entirely of small fibres, it is the action of the fibres that must be studied. As soon as understood they can be given intelligent protection. When anything is bent, internal friction is brought into play somewhere. This is proved by the increase in temperature of rods while bending. When a belt is bent, every fibre is forced to rub against its neigh-

Cut showing belt drive carefully and properly treated.

bor. It is the fibrous construction of a leather belt that makes it porous. These pores or spaces may be easily filled with any fluid substance, and unless first treated on the outside and well filled with some substance that resists moisture, the latter will easily get in and out. Alternate wetting and drying shortens the life of any kind of leather, as wearers of leather shoes or gloves well know. When suitable treatment is applied, it serves more purposes than one. In occupying all the spaces in the belt it surrounds every fibre and acts as a preservative lubricant for the fibres when one rubs against the other in bending the belt. An untreated belt wears out more quickly than one treated, because in bending the gradual grinding of the fibre hastens internal wear. Besides, this treatment gives a leather belt the kind of flexibility needed to insure non-slipping—a modern feature clearly shown in the cuts.

.. Various Belts and Their Treatment.

When new, painted cotton belts are fairly waterproof, due to the filler in them, and the paint on the outside. After being used for a short time, however, this gummy filler on the inside soon dries and cracks more or less; the paint outside cracks and wears or falls off, fissures appear at the edges and the fabric becomes filled with minute seams, which alternately gape open and chafe together as the belt goes around the pulleys. It is an easy matter for water to get in through the openings made, but not so easy for it to evaporate or get out; hence such a belt may rot in a short time. A waterproofing preservative will enter all these openings, easily making the belt as waterproof as it was when new, rendering it more serviceable, and making it more waterproof each time an application of the preservative is made.

A more troublesome belt is found in the unpainted cotton belt. An unpainted cotton belt is like a clothes line; with every atmospheric change it expands or contracts. However, when these belts are properly treated, they are made absolutely waterproof because there are no glued laps and because they are already filled with an impervious filler. The preservative readily penetrates between the fibres, mats them together, makes a heavier belt, more dense, with less stretch, with no possibility of cracking, and absolutely waterproof. This is a good belt for many purposes and low-priced. The well-stitched canvas belt made of plies of canvas is preferable to the woven webbing form of belt, as it stretches less and has more weight and density when waterproofed. A heavier belt is desirable because initial tensions can be readily reduced; if an initial tension is needed it is created by the weight of the belt itself.

Camel hair belts, although when new and through life are much better than ordinary unpainted cotton belts, because they are denser, heavier and tougher, are, nevertheless, similar in behavior to the stitched variety. They can be made equally waterproof.

The photographs given herewith show belts in actual operation in as many different plants, pulling loads that tax their full strength, with apparent ease. It is evident that a load pulled in this way reduces the shaft deflection to a minimum and thus increases the shaft's efficiency. The total pull is used in doing useful work. If the belt elongates, all the better—the arc of contact is increased, thus maintaining high belt efficiency. All of these advantages, especially that due to waterproofing, are worthy of earnest study. There is much to be gained in improving boiler, engine, dynamo and motor efficiencies, but unless belts are properly cared for, that gain is lost in the shafting and never gets to the machinery. Modern belt treatment, such as described here is largely responsible for the high belt and shaft efficiencies found in the most carefully-planned shops of to-day.

We are indebted to the Cling-Surface Co., Buffalo, N. Y., for the two cuts accompanying this article.

Correspondence

THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

By W. Norris, Executive President.

I HAVE been much amused at a letter which appeared in the December issue under the above heading and from the pen of "Generator," and am inclined to view that generator as I would one that is doing some suspicious sparking at the commutator, by getting into shape to give the attendant some fun in trying to get full efficiency at the switch-board. It looks as though "Generator" had an open circuit and was blaming the engine or other source of motive power, because it cannot put the required amount of juice on the transmission line and as we do not know the make of this particular type of machine, we may not be able to locate the trouble as we might if a little more data had been given. However, as we are not strangers to the blue jacket gang and are always at home when on the job, we will try and help "Generator" to run smoothly and get on the line once more.

"Generator" states that the C.A.S.E. has not fulfilled the anticipations of those who have been induced to become members, but he does not admit that the inducers are men who have had nothing more to gain than he, himself, in becoming a member. The invitation, "Generator" must remember, is extended to all other "generators" who are willing to run parallel and supply energy to the same line. My own experience, for over 20 years as an operating engineer and a member of the C.A.S.E., has taught me that I must ask myself what I am doing to better my position and that of the society of men in my own calling. I am in a position to say that a member of the C.A.S.E. will only get what he sets his mind upon to obtain. He must remember that this or any other organization can only prosper by the concerted efforts of each and everyone of its members, and without which no prestige can be brought to bear upon the powers that be. "Generator" must remember that the influence of the C.A.S.E. is governed by the efficiency of its members as engineers and brothers, in its truest sense, so that when he gets through diagnosing the disease of the C.A.S.E. and finds the above lacking, he can make up his mind that the trouble is not very far away and by the aid of a little better grade of solder on the connections, he will not have any stray currents.

Referring to legislation and a license law, Generator must know that what we have striven for and what we have obtained, has been due to the ordinary members of the C.A.S.E. Some of them have not stood still, but have moved up a little, and "Generator" has the same chance if he wishes. Allow me to say right here, that if we do not enjoy all that we could have wished it has not been the fault of those who worked to bring about better results. If the present conditions are to be improved, it will not be through the influence of letters like that written by "Generator."

Generator pays quite a tribute to the executive officers. He knows they are elected by the representative engineers at convention, and that each and every member has come from the common ranks. When he states they are inactive, he says so because he does not know better. He surely does not want all the work published until there are results to show for that work, and which results they have been appointed to bring about. If "Generator" has any complaint, it would have been much better if he had acquainted the executive president with same. As I said before, let us know his make. If you are a brother, show it, and you will gain the respect of those who are not, to say nothing about those who are.

Speaking about lack of organization, it is very unjust to charge the executive for any such fault when the individual members do not stand firm. This want of firmness has upset the work of years of hard labor of the association. Allow me to say at this point that the C.A.S.E. has always been the leading spirit in all matters advanced to promote the

interests of stationary engineers, and its principles have always been approved of by the powers that be. I am in a position to know, that had all the engineers in Ontario stood firm as a unit, to-day we would have had legislation that would have placed us on as good a basis as any other province in the Dominion. "Generator" refers to mutual interest of all engineers in or out of the organization. Well, what do members of the C.A.S.E. enjoy more than the non members as far as legislation is concerned. There is no legislation expressly for the C.A.S.E., but through the efforts of those interested in the C.A.S.E., the laws we now have have been brought forth, and all engineers, whether members of the order or not, enjoy equal rights. It has, however, been proven in scores of cases, that men through the instrumentality of the C.A.S.E. have advanced. "Generator" must remember that advancement is only in proportion to the energies of the young members, but not as knockers.

I feel that I am quite safe in stating that until the engineers of the whole province will become a unit and stand firm by the C.A.S.E., they will not enjoy legislation that will measure up to their expectations. I am glad to note that "Generator" does agree that the preamble and constitution are sure levers to gain the support of power plant owners, but that support will be governed by the steadfastness and progressiveness of the individual member of the Order, and no manufacturer or steam-user will have any fear, nor will they oppose any measure that is governed by the principles of such a constitution as that belonging to the C.A.S.E. I would earnestly advise "Generator" to fall into line and get into step, and to drop the hammer until he is sure that he is not in danger of smashing something good, just when it is about to become useful. If he is a member of the C.A.S.E., he is not ignorant of the fact that the letter he wrote is not in accordance with what should characterize a true and lawful brother of this or any other society of men who prize their honor above other external advantages.

FACTORY BOILER EXPLOSIONS IN ONTARIO.

IN REPLY to an inquiry from a correspondent, we have pleasure in publishing particulars of factory boiler explosions which have occurred in the Province of Ontario during the last three years. The information here given was furnished by Mr. James T. Burke, chief inspector of factories:—

1909—(1)—At Silver Water, Manitoulin Island, in a saw mill owned by James Crawford; portable boiler exploded, fatally scalding Frank Guin and slightly scalding James Haggar. Cause, sheet split inside fire box. (2)—At St. Clements, in the lumber mill owned by H. E. Ratz; boiler exploded, caused by valve being opened too quickly allowing steam to get into feed pipe or large engine. Walter Leaper fatally injured.

1910—(1)—At Cochrane, in lumber mill owned by William Breeze & Sons; boiler exploded killing one man and injuring another. Cause unknown. (2)—At Kenilworth, in the lumber mill owned by J. O'Neil; boiler exploded, but no one was injured. Cause unknown.

1911—(1)—In the Lake Superior Company's plant at Sault Ste. Marie; where no person was reported injured. (2)—Two explosions in Henry K. Wampole's plant at Perth. (3)—At the British American Colored plant, Toronto. All the 1911 explosions were not boilers, however, but were all caused by vaporous gases igniting.

GAS AND GASOLINE ENGINE QUERY.

By E. D. H., Halifax.

I would like Mr. White, the writer of the articles on Gas, Gasoline and Oil Engines, in the past few numbers of The Power House, to explain the reason why a 4-cycle engine comes to be made. They have so much extra gear in their make-up than has one of 2 cycles, besides, it costs more to build and run them, and to keep them in repair. Notwithstanding all this, the 4-cycle engine must have compensating advantages and of these I should like to be informed.

Societies and Personal

Mr. Baker, manager of the **Hamilton Carharrt Co., Toronto branch**, has resigned, and **C. F. Fell**, from the Detroit office has been appointed to succeed him.

* * *

W. J. Usher has been appointed manager of the Garlock Packing Co.'s new Winnipeg branch, and associated with him are **B. E. Dalzell** and **E. C. Medland.**

* * *

Arthur R. Bell has received the appointment of manager of the Garlock Packing Co.'s new branch at Vancouver, and will have as assistant, **Geo. Cook.**

* * *

Hugh Jackson, treasurer of the Positive Clutch & Pulley Co., has resigned his position to become cashier of the Canadian Fairbanks-Morse Co., at Calgary.

* * *

Mr. J. F. I. Thomas, who superintended the erection of the Hydro-Electric Plant for the city of Winnipeg, as representative of Vickers, Ltd., is now permanently located in Montreal, where he will look after the electrical end of Vickers, Ltd., business throughout the Dominion of Canada.

* * *

R. H. Noble, who was employed by the Canadian Fairbanks-Morse Co. previous to his entering the organization of the Positive Clutch & Pulley Co., Toronto, has accepted a position with and now has charge of the transmission department of the Canadian Fairbanks-Morse Co., at Toronto.

* * *

L. W. Rundlett, who has been appointed Engineering Commissioner at Moose Jaw, on a salary of $60,000 a year.

* * *

Harold Smith, production engineer for the Canada Foundry Co., Toronto, has accepted a position as assistant superintendent of Mather & Platt's whole plant, at Park Works, Manchester, Eng. Previous to coming to Canada he was in the employ of this latter firm for 10 years, 4 of which were spent in the capacity of shop superintendent of the electrical department. In addition to his recent appointment with the Canada Foundry Co., Mr. Smith was for two and a half years and one year respectively, superintendent of the Montreal Light, Heat & Power Co. repair and manufacturing shops, and that of the Canadian-Crocker-Wheeler Co., St. Catharines, Ont. Mather & Platt have during the last 10 years been rebuilding, re-equipping and reorganizing their whole plant, provision for same having been made by the purchase of 40 acres of land 2½ miles outside Manchester. The firm employ from 1,200 to 1,500 men, and while claiming to be the largest turbine pump manufacturers in Europe, they, in addition, do an extensive business in all manner of fire, hydraulic, electrical, mechanical and textile machinery. Mr. Smith sails for England early in February.

* * *

Owen Sound, No. 25, C.A.S.E., report the closing meeting of the year as having been particularly successful. A resolution was adopted endorsing the sentiments expressed in the letter by "Generator" in the December issue of The Power House, and ordering same to be placed in the published report. Further, a petition was drawn up for signature by engineers and manufacturers in Owen Sound and vicinity, to be thereafter presented to the M. P. for that division of the Ontario provincial parliament, as a plea for him to help along the passing of an act whereby the engineers of the province will be granted graded certificates.

The hope was expressed that all other lodges of the C.A.S.E. would take similar steps and keep at it until the end aimed at was accomplished.—W. J. Needham.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. V. JANUARY, 1912 No. 1

TOO TECHNICAL ARTICLES.

WE HAVE received many highly appreciative comments on the article appearing in our December issue, entitled "Horse Power Years vs. Kilowatt Hours—Which Pays Best," and as a few of those readers, who so expressed themselves, inclined somewhat to the opinion that the matter was, if anything, a trifle too technical, we are taking this opportunity of saying a word on the subject.

It should be stated at the outset, that this particular article can in no sense be termed a technical treatise, and that it is the duty of every operator to have himself become conversant with the simple arithmetical features and applications therein contained. No man has a right to call himself an engineer who cannot master the elementary calculations involved and follow the simple yet effective practical reasoning which the writer of the article has so attractively set forth. Further, every operator who has his own best interests at heart should at once set to the equipping himself for the task, if he be not already qualified. There is, it seems to us, too much of a tendency to dub an article as more or less technical because a few multiplication signs are interspersed throughout the text, and because such combination words as "horse-power, kilowatt-hour, per centage., etc., are printed in abbreviated form. Again, unless we can, as it were, see the point or series of points, which are intended to be conveyed, at a glance, or with the minimum mental and possibly physical exertion, we are sure to take refuge in the played-out and antiquated over-technical shelter.

In the mental as well as the physical, an appetite and good digestive organs are prime requirements, and for the sharpening of the one and the highest effect of the other, it is necessary for us to "rustle" somewhat if we would secure practical educational refreshment. There is no special aptness required in the pursuit of greater knowledge and the more intelligent application of same to one's business or calling, and while the granting of graded certificates will aid very materially in giving zest to measures of self-improvement among power plant operators, there is no reason why the good work should not be proceeded with in the interval. The admission, that an article, address or lecture is too technical, should always be very guardedly given expression to, carrying as it does in a great many cases an impression of weakness and incapacity. We are living in an age where progress and development towards more perfect attainment are everywhere in evidence, and in which the personal factor of ability and capacity for sharing in its consummation becomes of increasing moment; it is idle and criminal, therefore, to misinterpret and misname plain, wholesome instruction. Such a proceeding is besides, an unwarranted distribution of compliments to the authors of various practical treatises, and liable to engender within them a false conceit of superiority of culture and intelligence. A wise study will tend to eliminate altogether such expressions as "technical," and "too technical" from our vocabulary.

POWER PLANT AUXILIARY EQUIPMENT

PERHAPS the most noticeable feature in the realm of present day power plant engineering is that of high-grade and improved auxiliary and accessory equipment. One has only to make an intelligent inspection of the advertising pages of a technical publication devoted to this phase of the subject or make a careful examination of the myriad devices and apparatus to be found in a modern power plant installation, in order to see and realize to what extent advance has been made in the direction of systematic, efficient, economic and automatic auxiliary mechanisms. The main power units—the boilers and engines, while improved considerably in design, detail and workmanship, show no great advance in higher efficiency attainment, although the advent of the steam turbine, and particularly that of the low pressure type, operated in conjunction with the reciprocating engine, has led to quite a marked gain in over-all previously existing achievements. This low pressure turbine might almost be classed, however, as an auxiliary, and more properly so, when installed as an adjunct to an existing reciprocating steam engine.

The greatest improvements to be accounted, are those affecting the condensers, air, feed and circulating pumps, mechanical stokers, feed water heaters, purifiers and superheaters, and the more practical design of such accessories as boiler and pipe valves and fittings, scale and soot removers, etc. The record of marine engineering for the year 1911, bears out, perhaps, even more strikingly, the rapid strides made in this sphere of power auxiliary attainment, than does that of stationary practice, yet, in the past it has been noticeable that not more than a short head separated the two, therefore, to those looking for the highest efficiency and economy of operation of a power plant, large or small, there is afforded no lack of well provided mechanisms to further their aim.

GAS AND OIL ENGINE PROGRESS

A record of principles of design, construction and achievement in a rapidly developing sphere of power generation.

BLAST FURNACE GASES.

IN bis presidential address delivered before the West of Scotland Iron and Steel Institute, Mr. Walter Dixon said "that it was now recognized that blast furnace gases used in gas engines could develop not less than twice the power which was capable of being developed in steam engines using gas-fired boilers, and it was a question for each particular works to decide how far, and to what extent, they were justified in using their gas as at present, in an admittedly uneconomical way, or how far, and to what extent, it was reasonable to avail themselves of the demonstrated possibilities of gas power. The case was different with foreign competitors. With them blast furnaces were generally associated with steel and other works requiring power, and the rapid increase in the number of gas engines now employed on blast furnace gases showed to what extent the possibilities had been recognized. The distribution amongst various countries of 1,033,509 b.h.p. of large gas engines was :—Germany, 46.5 per cent. ; America, 32.5 per cent. ; France, 5.4 per cent. ; Belgium, 4.6 per cent. ; Austria-Hungary, 2.4 per cent. ; Great Britain, 2.4 per cent. ; and other countries, 6.2 per cent. Of this power, 84 per cent. was employed in iron and steel works, 6 per cent. in collieries, 3 per cent. in electricity works, and 7 per cent. in other directions. In his opinion the reason for the advance in the adoption of the gas engine on the Continent and in America was largely the advent of the electrically-driven reversing rolling mill, which practically dispensed, with steam, and at once opened the way to a large economy by the practical elimination of the boiler range and the utilization of the available gases to the full.

A steel works should not and could not depend safely on a large and regular supply of power where only two or three blast furnaces were in use, as the working of the furnaces would not be sufficiently regular nor the gas sufficiently constant either in quality or quantity. These difficulties could be overcome to a large extent by the introduction of a comparatively inexpensive gas producer plant to act as a stand-by. In such a way it was possible that the fullest use could be made of the gases from a small number of blast furnaces to furnish the necessary power in an adjoining works ; but how far such methods could be applied economically depended in each particular case, on the value and condition of the existing steam raising plant and the cost which would be involved in replacing the steam by gas-driven plant. Steel makers abroad obtained their power, practically speaking, for nothing, while in many British works, almost every horse-power must be developed by the actual utilization of coal in steam boilers.

The question was, how could this coal be used to the greatest advantage ? The time had surely passed when a British steel-maker should hesitate to generate his power by gas engines. Many works now depended successfully on such engines, and it might be taken as a fact that a properly equipped gas engine station, on modern lines, was as trustworthy as any other type of station. It was also true that, horse-power for horse-power, the power could be raised by this method for, say, one-half the coal that was being expended at the present time in the case of boiler firing. Gas engines up to 5,000 h.p. could now be obtained to give out one-horse power for about 1¼ lb. of coal, which coal could be gasified in producers of simple and inexpensive type. In this way economical development of power should demand careful consideration, even where blast furnace gases were not available.

Gas Producers.

There was, however, another means by which the cost of energy could be further reduced—by the introduction of gas producers coupled with ammonia recovery and by-products plant. The recovery of by-products marked an era in the economies of blast furnace operations, and it equally marked an era in the economy of steel works practice. Such plants had been already installed in several important works which had not the advantage of being connected with blast furnaces. The gas was raised from producers with which an ammonia recovery plant was connected, and from each ton of fuel so gasified, sulphate of ammonia of a gross value equal to, or exceeding, the original cost of the coal was being obtained continually—probably the nearest approach to "gas for nothing" which would be obtained by any method other than a blast furnace plant. In either process, apart from the cost of the plant itself, the energy in the fuel might be considered a by-product, while continuous rolling mills were being driven direct-coupled to gas engines, and a large part of the auxiliary machinery was being worked electrically from power so generated.

NATIONAL GAS ENGINE ASSOCIATION.

AT the last meeting of the National Gas Engine Association there were taken a number of steps leading to constructive work for the betterment of the trade. Among these was the appointment of a committee on publicity to secure, compile and publish information or data that would instruct the general user of gas or gasoline engines and help to disseminate educational literature on the subject. President Parker has appointed this committee as follows: H. W. Jones, Chicago, chairman; Prof. P. S. Rose, Madison, Wis., and Mr. H. F. Smith, Lexington, O. These gentlemen are acquainted with the various factors entering into the gas-engine business, and are well qualified for the work of this most important committee.

The Association decided to take some steps towards securing a design for an emblem or association button. The Executive Committee was authorized to order a cash prize and to prescribe such rules as they see fit for a competition along this line. Particulars of this will be announced later.

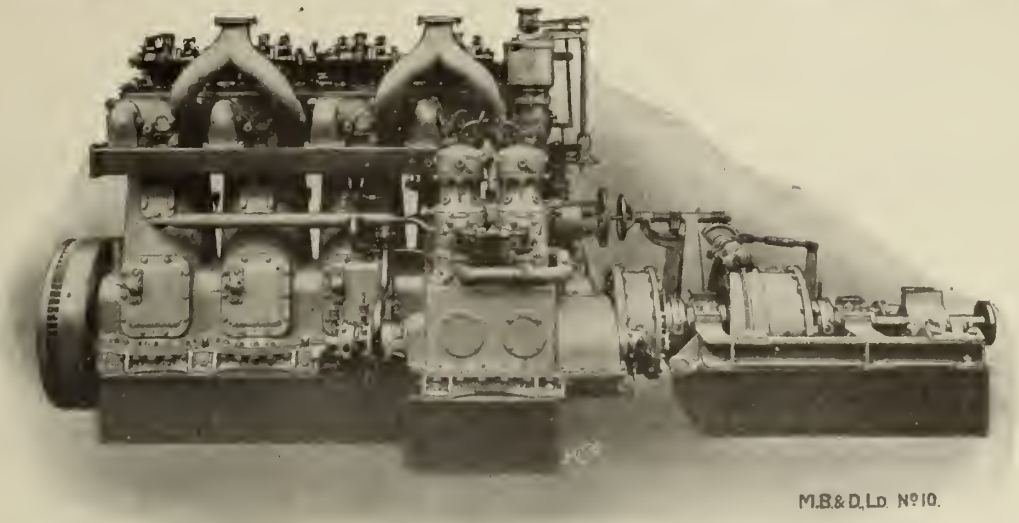
In order to stimulate membership-getting, rival membership committees are being organized for teamwork. These gentlemen will be picked by the president for their hustling capabilities, and will be on the trail of anyone showing the least sign of interest in the organization. At the next convention, to

be held in Milwaukee about June, one of these committees will be furnished a dinner at the expense of other committee—the loser.

President Parker and the members of the trade in and around Milwakee are taking up their plans for consideration of a possible gas-engine exhibit or show, and it is probable that complete announcement of the plans will be forthcoming shortly. The idea seems to have met with instant response from many of those who would likely be exhibitors, and this shows that the Association has created, during its three years of existence, a nucleus for a national display of gas engines and allied lines.

Membership is open to any who are interested in gas or gasoline engines or accessory lines. The cost is $5 initiation and $5 dues annually. Any of the officers will be glad to receive applications from those interested in affiliating with this organization whose object is to promote the gas and gasoline-engine business and to benefit all who are in any way affected by this business, from manufacturer of engines and accessories to the user of the engine. Dealers are especially invited to membership, with a view of better equipping themselves for the successful handling of a class of machinery which is every day becoming a more and more important factor in the business of furnishing power to the manufacturer as well as to the farmer.

The officers follow: O. C. Parker, La Crosse, Wis., president; H. W. Jones, Chicago, Ill., first vice-president; Otto M. Knoblock, South Bend, Ind., treasurer; Albert Stritmatter, Cincinnati, O., secretary; executive committee, Otto M. Knoblock, South Bend, Ind., H. W. Jones, Chicago, Ill., Harry T. Wilson, Middletown, O., M. A. Loeb, Cincinnati, O., O. G. Parker, La Crosse, Wis., E. J. Perkins, St. Joseph, Mich., O. B. Iles, Indianapolis, Ind., H. W. Bolens, Port Washington, Wis., C. O. Hamilton, Elyria, O.

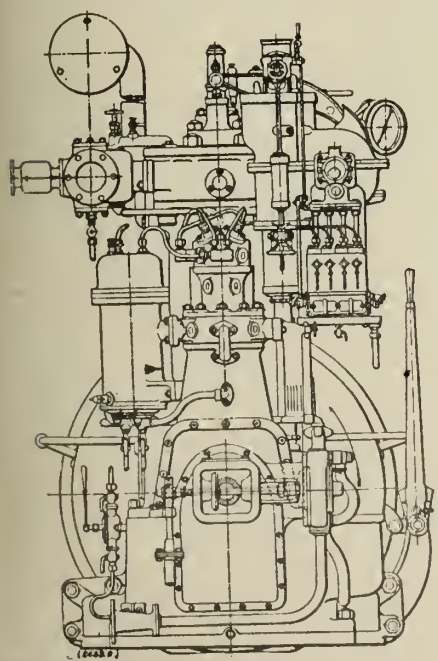


120 B.H.P. Mirrlees-Diesel Oil Engines for Propulsion of 50 ft. Admiralty Pinnace.

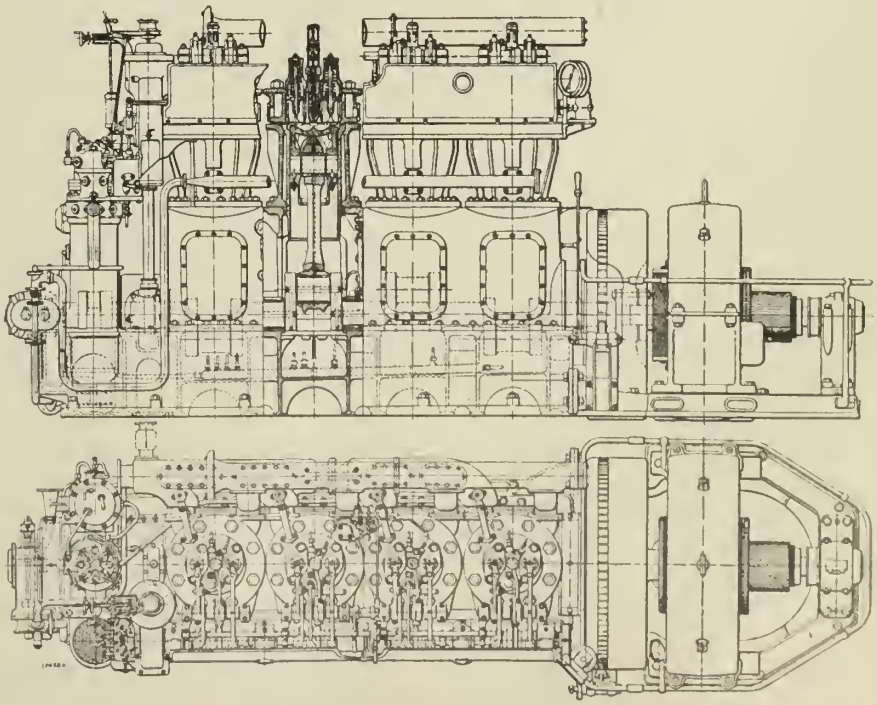
THE "MIRRLEES-DIESEL" OIL ENGINE.

By Helenslee.

THE rapid development and progress apparent in the realm of internal combustion engines makes incumbent, on proprietors and operators of power plants, a more than passing knowledge of what is being achieved in this direction, and despite the utilization for some



End Elevation of 160 B.H.P., 4 cylinder, 4 cycle, "Mirrlees Diesel" Oil Engine, direct-connected to generator.



Front elevation and plan of 160 B.H.P., 4 cylinder, 4 cycle, "Mirrlees Diesel" Oil Engine, direct-connected to generator.

years to come, possibly of water power and steam plant installations, there is undoubtedly looming up on the near horizon, a formidable competitor to both, where questions of power generation are involved. The Diesel oil engine is being surely and steadily improved and perfected, due to its principles of design, construction and operation being more clearly understood, and the fact that a number of units are already installed in Canada, with prospects of being still further added to in the present year, goes to show that in many quartres of this Dominion those interested in power plant practice are alive to the attainments and successes of the most modern and up-to-date equipment available.

The "Mirrlees-Diesel" engines are all of the vertical type, and their mechanically operated valves are arranged in the cylinder covers. Each valve has a removable seat, being a very important improvement, as it enables the engine attendant to grind-in spare valves at his leisure instead of having to do it while the engine is stopped. When a valve on the engine requires attention, he has only to pull out the valve and seat and replace them by a spare valve and seat.

Cycle of Operations.

The engine is single-acting and operates upon the well-known 4-stroke cycle, one stroke in every four being a power stroke. The cycle is as follows:—

1.—On the first down-stroke of the piston, air is drawn direct from the atmosphere into the cylinder (note that air only, not a mixture of air and gas or oil vapor, is drawn into the cylinder).

2.—On the first up-stroke this air is compressed; this compression causing the temperature of the air to rise sufficiently to ignite fuel sprayed into it.

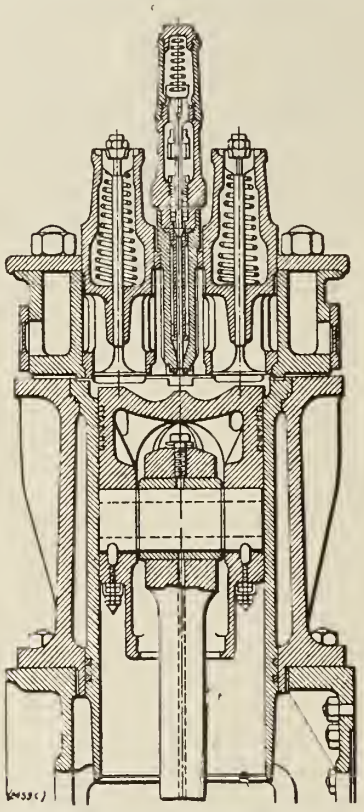
3.—At the end of the compression stroke, and during the first period of the succeeding down stroke, fuel oil is blown into the cylinder by compressed air; the oil is sent into the cylinder in a finely divided spray, and is not injected suddenly, but over a measurable period of time, thus avoiding any rise of pressure after the completion of the compression stroke. The amount of oil thus delivered to the cylinder is controlled by the governor so as to suit the variations of load.

4.—The next up-stroke is the exhaust stroke, during which, the products of combustion are expelled to the atmosphere.

From the foregoing description, it will be seen that there is no explosion or sudden rise of pressure in the working cylinder, hence greater smoothness in running and absence of concussion; also that as air only is compressed, there is no possibility of premature ignitions. Further, as the oil is ignited by the heat produced by the compression of the air, no troublesome sparking or ignition devices are required. It will also be noted that no carburetter or vaporiser is necessary.

Air Compressor.

The compressed air required for blowthe fuel into the cylinder, as also for starting-up, is supplied by a two-stage air pump which forms part of the engine, being direct-driven from a crank formed at one end of the crank shaft. The "Mirrlees" were the first to operate the air compressor in this manner, thereby eliminating a complicated system of linkwork, when driving the air compressor from the connecting rod. Another feature is a patented device for



Cross section through a cylinder head of the 160 B.H.P., 4 cylinder, 4 cycle, "Mirrlees Diesel" Oil Engine.

reducing the consumption of lubricating oil. It also prevents oil reaching the valves, thereby rendering them free from carbonized oil, and making them reliable and suitable for long periods of working without attention. This compressor has been brought to a high state of efficiency, and embodies many important improvements in its details of construction.

Lubrication and Fuel Bye-Pass.

Great attention has been paid to ensure perfect lubrication of all the working parts in the simplest and most efficient manner possible, so that the attention of the engineer to this important factor is practically only five to ten minutes a day.

Previous to designing a fuel bye-pass gear, the fuel oil was—during the starting of an engine, with the needle valve or fuel admission valve out of operation—pumped for several strokes by the fuel pump into the casing around the needle valve; as a consequence, by the time the starting operation was completed, there was considerable accumulation of fuel oil, and this was blown into the cylinder when the needle valve was put into operation by the starting handle. This excess of fuel oil was liable to cause excessive pressures and do injury. The bye-pass device obviates this.

Cost of Running.

The cost of running Diesel engines depends, of course, primarily on the cost of fuel oil. This rose steadily in price up to the end of 1907, but has recently shown signs of an equally steady decline. In considering the price of oil, it is important to remember that the "Mirrlees-Diesel" engine works equally well, and without any alteration, on residual petroleum, residual shale oils, natural petroleum, refined oils, or practically any clean fuel oil. By residual oils we mean the residue left after the natural oil has passed through the distillers, and has had driven from it all the lighter oils. This residual oil is commonly spoken of as "crude oil." Care should be taken, however, to stipulate oil free from tar and acids.

Oil Consumption Per B. H. P.

With varying loads, the following figures have been obtained from Diesel oil engines on trial and during service, a perusal of which makes possible an accurate calculation as to cost of operation, and, further enabling a comparison to be made with other forms of generators:—

Full load . . .	.5	lb. per	b.h.p. per	hour.
¾ load	.52	"	"	"
½ load	.6	"	"	"
¼ load	.8	"	"	"

For larger engines the fuel consumption per b.h.p. is lower, and even for small engines the figures stated leave a margin.

Experience has shown that the cost of repairs and wear and tear are very low, and compare more than favorably with the figures of most other engines.

The Diesel, besides being most economical, shows a high thermal efficiency.

The half-tone illustration shows a 120 b.h.p. Mirrlees-Diesel engine used to propel a 50-ft. admiralty pinnance and the line cuts, a 160 b.h.p., 4-cylinder, 4-cycle "Mirrlees Diesel" engine direct-connected to a generator. Mirrlees, Bickerton & Day, Ltd., Hazel Grove, Stockport, England, are the makers of the Diesel engine, whose features we have just described, and their representatives in Canada are the Canadian Boving Co., 164 Bay street, Toronto, to whom we are indebted for the accompanying cuts.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

ELECTRICAL MACHINERY, ITS CARE AND HANDLING.

By Roderick Grant, Toronto.

UNDER the above heading in the December issue, we confined our observations mainly, to the care of the commutator and to the setting of the brushes on direct current machines, and it is because we are aware how difficult it is to get engineers or attendants, who have had little or no electrical experience, to appreciate how easily a serious fault may develop from what might appear to be a trifling cause, that we repeat and urge the necessity of giving to the parts named the most careful attention and of taking prompt action to remedy any condition that might conceivably cause trouble. It augurs well if a highly polished dark skin forms on the commutator surface, indicating, as it does, that there is the minimum of wear. The surface then, on no account should be disturbed with sandpaper, for an occasional wipe with a clean dry rag will usually prove to be all the treatment required. It is sometimes advantageous, however, to wipe the commutator with an oiled rag, especially if the brushes become noisy. This treatment also removes any gummy substance present, and which on no account should be allowed to accumulate.

Defective Insulation Due to Oil Leakage.

At this time of day, when the disastrous results to insulation from moisture or dampness are so well known, it is perhaps needless to insist on the precautions to be observed in that direction, but there is another source from which impaired insulation results equally disastrous, and we regret to say of much too common occurrence. We refer to the indiscriminate use of lubricating oil. It is of course necessary that all bearings should be thoroughly lubricated, but great care should be taken to see that the oil does not overflow, run along the shaft or collect about the frame where it might affect the windings. In most modern machines, the armature is protected by shields on the shaft which arrest the creeping oil before getting to the windings, and manufacturers have given considerable attention to the design of lubricators, to insure that no splashing takes place. The trouble to which we refer, is in most cases, simply due to flooding, and not only is it wasteful but at the same time positively dangerous.

Bearing Lubrication and Effects of Wear.

Electric motors and generators are as a rule provided with ring lubricators which under favorable conditions give perfect service. An occasional examination should be made, however, to ensure that they are working freely, as a slight deposit of sediment in the oil reservoir will often prevent the ring from being carried round on the shaft. Further, it is not unusual for a ring to spring from its seat by increased vibration, and to take up an ineffective position. This trouble can be guarded against by soldering a piece of stout wire across the slot in the bearing wherein the ring lies. Only good clean mineral oil should be used, perfectly free from grit, and the reservoirs should, periodically be thoroughly cleaned out.

Perhaps the chief importance of keeping the bearings in good order lies in the fact that if any wear takes place the armature is thrown out of centre, and the pull exerted by the pole piece toward which it lies becomes tremendous as the neutralizing influence of the opposite pole is lessened. This not only disturbs the magnetic and electrical balance, causing undue heating of the armature and sparking at the brushes, but the wear of the bearings is greatly accelerated until finally the armature rubs on the pole face, damaging more or less severely the insulation. The necessity therefore of keeping the armature exactly central or equidistant from the field magnets will be readily appreciated and frequent inspection should be made in order to ascertain if any wear is taking place. To this purpose, it is advisable where several machines are in use, for the engineer to have at hand a number of flexible strips of wood of the required lengths and thickness. These may be conveniently kept together by means of a ring passing through a hole near one end. Each strip can be inserted in turn and the exact amount of clearance at all points thus readily determined. Although this method is the more reliable the same object may be accomplished by holding a lamp at one end of the armature, when the amount of clearance may be seen from the opposite end. It is possible, however, that the armature may be out of centre without any appreciable wear having taken place at the bearing. A bent shaft, the shifting of one of the field magnets, or a loose armature winding would each contribute to this. In any case, it is no difficult matter to determine exactly what is at fault.

The bearing at the driving or pulley end of the shaft, owing to the extra strain, is subject to most wear. This if once started, for reasons already stated, develops rapidly, so that, on the least indication of this trouble, preparations should be promptly made to have the fault remedied at a time that will cause least inconvenience. The danger of having a bent shaft is not so great, as not only are special precautions taken by all reliable makers to obviate such an occurrence, but it is only under certain conditions that such a thing would be likely to happen. For instance, if the armature were unusually long, the danger would be increased ; or if by any chance the machine were allowed to race and exceed its normal rate of speed, the centrifugal force would exert a tendency more or less severe in that direction.

In spite of the precautions that are taken in dynamo and motor design, vibration will sometimes cause a slight displacement of the pole pieces and of the field magnet coils. The measures to be adopted under such circumstances will entirely depend on the manner in which these parts have been fixed, but on the location of the fault, there is seldom much trouble experienced in making the necessary adjustment. Projecting coils on the armature should be pressed carefully and firmly into position and if necessary held by extra binding wire.

WATER-POWERS OF CANADA.

THE first inventory ever taken of the water-powers of Canada has been completed by the Commission of Conservation and the results embodied in a large and profusely illustrated report just issued. The investigation made by the Commission which has extended over a period of two years, shows that there are 1,016,521 horse-power developed from water-power in Canada. Every phase of the subject from the laws governing the disposition of water-powers in the various provinces, to the actual physical data regarding each individual water-power concerning which information was obtainable, is treated in the report. In addition, there is a very full bibliography of 30 pages, and appendices giving, among other things, the text of the laws concerning the export of power and also of the treaty recently concluded with the United States regarding the establishment of an International Joint Commission.

General Information on Water Powers.

The volume opens with two chapters of an introductory nature that are concerned mainly with the general economic bearing of water-powers on national development. The relation of water to agriculture, mining, navigation, domestic supply and so forth, is dealt with, and the principles to be used in the interpretation of water-power data are stated and discussed critically. The broad and optimistic statements very often made on the platform and in the press regarding our vast water-power resources are deprecated. To quote from the Report, "General statements implying that the aggregate amount of water-power must be great because the total water area, or watershed area is so great, or because there are so many lakes and rivers, are generalities to be considered of very little definite value. One of the chief dangers of such generalities is to create in the popular mind a feeling of unwarranted assurance that, even though desirable water-rights are being granted by a government, yet there is so much left, that no apprehension may be entertained regarding the amount of power rights being parted with."

Valuable Statistics for Each Province.

A chapter is devoted to the water-powers of each province in which the general features of the province as regards water-power development are discussed and an outline given of the law whereby powers are granted or leased to private individuals or corporations. The larger developments are also described. The statistical data given in tabular form includes the height of the fall, the horse-power that may be developed, the present development and the main uses to which the power is applied, such as lighting, pulp and paper making, etc. Reference is also made to the possibility of increasing the amount of power developed by storage reservoirs and dams where such are feasible.

Less Power Available at Niagara Than Expected.

The power situation in Ontario is treated very fully, special attention being given to the power possibilities at Niagara, and the conditions affecting development there. Each of the power companies operating there, whether on the Canadian or American side, is described in detail. A significant reference is made to the granting of franchises to develop power at Niagara Falls. The report states that the low-water flow of the Niagara river would yield at the Falls, about 2,250,000 h.p., of which Canada's share (one-half), would be 1,125,000 h.p. "Franchises have already been granted," it goes on to say, "and plants partially completed, for the development on the Canadian side of the river, of about 450,000 h.p. In other words, instead of 'millions' of horse-power being available, as has been sometimes stated, it appears that about half, and by all odds the better half, of Canada's usable share of Niagara Falls power has already been placed under private control."

Special Report on Western Powers.

The volume embodies all the useful information regarding the water-powers of Canada that has heretofore been collected and this has been supplemented and, in many cases, verified, by field surveys, conducted by the engineers of the Commission. In fact, all the information regarding the Maritime Provinces powers was obtained in this way last year by the experts of the Commission. The data regarding the Western Provinces was found to be so incomplete that it was decided to make special investigations of the powers in those provinces, the result of which will be published next year in the form of a report on the "Water-Powers of Western Canada." The engineers of the Commission are now engaged upon this work.

BRITISH COLUMBIA ELECTRIC RAILWAY STAFF CHANGES.

Mr. Allen Purvis, Supt. of Interurban lines of the B.C.E.R. Co. system has resigned his office. His place has been taken by Mr. G. H. Franklin, formerly local manager of the company's Lulu Island interurban division, as acting supt. of interurban lines. Mr. Franklin's former duties have been assumed by Mr. E. Sterling, formerly train master on the company's Interurban lines at New Westminster. The management of the company has also accepted the resignation of Mr. W. H. Elson, local manager of the New Westminster lines, but no appointment has yet been made for this post. Mr. W. T. Woodroofe, who has been connected with the B.C.E.R. Co. for a number of years and is now filling the position of supt. of power and lines, has been chosen by the Vancouver city council as city electrician, vice Mr. J. A. McCrossan, deceased. He will probably sever his connection with the company in the immediate future.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY.

One of the most successful dinners in its history, was that of the Engineering Society of the Faculty of Applied Science of the University of Toronto, held recently. It was the twenty-third annual function, and there were present graduates from as far back as thirty years ago. Mr. W. B. McPherson, president, was in the chair. A very interesting address on the progress of the work undertaken by the Dominion Conservation Commission was given by Secretary Patton of that body, who came at the request of the Chairman, Mr. Clifford Sifton, after the commission closed its annual meeting at Ottawa.

Dr. Ellis responded to the toast of the University, and Mr. W. F. Tye, consulting engineer, and president-elect of the Canadian Society of Civil Engineers, in responding to that of "The Engineering Profession," gave the students a history of old-time engineering as compared with that of the present, pointing out the difference in the way the profession and the public used to treat graduates of engineering schools and the way they are now treated.

Mr. George Guess, the new professor of metallurgy, was introduced and spoke briefly, while Dean John Galbraith made a short speech on engineering and university topics in general.

Student representatives were present from McGill and Queen's Universities, and among the guests were Mr. W. B. McPherson, K.C., M.P.P.; Mr. P. W. Ellis, of the Toronto Hydro-electric Commission; Mr. J. W. Tyrrell, the Arctic explorer, of Hamilton; Mr. P. W. Sothman, chief engineer of the Ontario Hydro-electric Commission; Mr. C. H. Rust, outgoing president of the Canadian Society of Civil Engineers; Dean B. E. Fernow, of the University Faculty of Forestry; Engineers J. G. Sing, Willis Chipman, T. Aird Murray, and Controller Church. The School of Science Orchestra and the science octette gave several selections.

REFRIGERATION DEPARTMENT

REFRIGERATION AND BRINE.

By W. G. Walters, Stratford.

IN THE equipment and installation of a refrigerating plant on the cold air system, provision must be made for a concentrator or evaporator tank. With the brine system, in which the brine is circulated through a series of coils, there is no need for an evaporator, as the quantity of brine remains constant. Due to the circulation of the air in the chilling of animals and other commoditics in which there is humid heat, the quantity of brine in a cold air system gradually increases, the moisture being collected and carried by the air to the brine tanks, and there deposited in the latter by the process of cooling and washing. If provision be not made for this increase in the quantity of brine, the tanks would soon overflow and in addition its strength would be materially decreased.

Chloride of Calcium Brine.

Results show that the increase in quantity is much greater when the brine is made from chloride of calcium as compared with common salt. Calcium chloride is one of the best absorbers of moisture known to science.

This absorbing nature of chloride of calcium brine makes it of more value in a sanitary way, than brine made from other chemicals or salt. Another valuable feature is the economy of pumping. It can also be carried at a much lower temperature than salt brine, therefore, a proportionately smaller quantity need be pumped. One pound of brine, circulated at 10 degs. Fahr. through coils in a room, which has to be maintained at 30 degs. Fahr., is as efficient as 2 pounds circulated at 20 degs. Fahr. Calcium brine is a much more fluid oily liquid than salt brine, and therefore, will flow through the pipes with less friction, effecting, thereby, a saving at the brine pump.

A chloride of calcium brine, testing about 80 degs. salinometer, has the same freezing point as a salt brine testing 100 degs. salinometer. It will be noted that salt brine is 20 degs. heavier than calcium brine and yet has the same freezing point, in other words, they will both carry the same unit of refrigeration; but if one solution is lighter in density than another, the lighter solution will absorb more heat per cubic ft. and absorb it quicker, consequently a cubic ft. of calcium brine passing through a pipe in a cold storage room will take more heat out of that room than would a cubic ft. of salt brine, and do it quicker. This means that it is not necessary to pump as fast; the result being less power required for pumping and, therefore, a reduction in the fuel bill, as also an increase in refrigerating capacity. There will, however, be a slight increase in the amount of shrinkage in the cooling of animals, when chilling is done with cold air, but this will be offset by the improved sanitary conditions prevailing. In the cold air system, the strength of the brine, while an important feature, is not as closely associated with the economical side of refrigeration as it is in the brine circulation system, for if the brine in the case of the cold air system is of a strong enough nature to keep the frost from forming on the expanding coils situated in the tanks, the unit-of-refrigerating effects will depend almost entirely on the amount of gas circulated by the ammonia compressor. In the case of the brine system, the units-of-refrigeration depend on the strength of the brine, and also on the amount of gas that is handled by the compressor.

Regulation of Temperature.

In cold storage rooms where the refrigerating work is regular and the temperature of the brine returning to the refrigerator is not liable to vary many degrees, the regulation of the temperature of the outgoing brine is an easy matter; but when the returning brine is subjected to large variations in temperature, the regulation of the outgoing brine temperature requires a great deal of attention. In the former case, the expansion valves are regulated so that the compressor maintains a suction pressure equivalent to a boiling point (of the anhydrous ammonia) of about 15 degs. Fahr. lower than the brine temperature required. For instance, in ice making, a brine temperature of 25 degs. Fahr. would be the most economical, and 15 degs. lower than that, namely 10 degs. Fahr. would be the temperature at which the ammonia should boil. It will be understood that a suction gauge pressure of about 24 lbs. is equivalent to an ammonia boiling point of 10 degs. Fahr. and, therefore, the expansion valves would require to be regulated so that the compressor ran with a suction gauge pressure of say 23 lbs. If a huilding has to be cooled and maintained at a temperature of zero, a brine temperature of about — 10 degs. Fahr. will be necessary, and 15 degs. lower than that (— 25 degs. Fahr.) will he the required hoiling point of the ammonia, with a suction gauge pressure on the compressor of ahout 1.5 lbs. In hoth these cases, the expansion valves will require little or no attention after they have once heen properly regulated.

Cooling Efficiency.

If, for instance, we have a quantity of hot lard to be cooled a certain number of degs. Fahr. in a given time, it is necessary that the expansion valves shall he frequently attended to in order to ohtain desired results. For example, 50,000 lhs. of lard at a temperature of 100 degs. Fahr. have to he cooled to 20 degs. Fahr. or through 80 degs. Fahr. in 24 hours and the specific heat of the lard is .750. In this case, the number of thermal units to be extracted from the lard are 50,000x80x.750=3,000,000. Now, if the compressor is capahle of circulating 43,200 cuhic feet of ammonia gas per 24 hours, and the expansion valves are regulated to give, at the commencement of the run, a brine temperature of 15 degs. Fahr., then the refrigerating efficiency will he only 2,497,000 thermal units per 24 hours; it will, therefore, take about 29½ hours to cool the lard to 20 degs. Fahr. If, however, the expansion valves are regulated so that for the first 6 hours the brine temperature will be about 32 degs. Fahr., during the next 12 hours 25 degs. Fahr. and for the remaining 6 hours, 15 degs. Fahr., the refrigerating efficiency will he approximately:

First 6 hours..	882,000	Thermal units
Next 12 hours.	1,542,000	" "
Last 6 hours..	624,000	" "
Total	3,048,000	" "

This is 48,000 thermal units in excess of what is theoretically required, and 551,000 thermal units more than could he extracted hy starting with and maintaining for 24 hours the required final temperature of the hrine, namely, 15 degs. Fahr. This great difference in the results is due to the simple fact that the refrigerating efficiency of a

system is proportional to the weight of anhydrous ammonia circulated. Therefore, if a large weight of ammonia is circulated at the commencement, when the temperature of the commodity to be cooled is high, and that weight be gradually reduced as same becomes cooled, it is evident that the lard or other hot substance will he cooled quicker than if the smaller weight, or that necessary for the final temperature is circulated throughout the whole of the operations. Of course, it would not be advisable to regulate the expansion valves so as to cause three sudden drops in temperature as in the above example, where it was done for simplicity sake, and to illustrate how the desired results could be obtained. The valves should rather be gradually closed so that the minimum brine temperature required will be reached in about 6 hours before the substance being cooled is wanted. An important advantage of the cold air and brine circulating systems over the direct expansion system (outside of the sanitary value) is the ability to store refrigerating energy in the hrine tanks which may be utilized during the night, in case of shut-down or accident to some of the machinery, or in case of necessary repairs to the compressor.

In some establishments the brine is cooled in the day time, and enough refrigerating units are stored up in the tanks to allow the compressor to he shut down during the night; only the brine pumps and pans being run during the night. In these circumstances a larger system of expansion coils and brine tanks are installed. This arrangement tends to very economical operations, for in cases where the expansion coils and brine tanks are too small, the compressor will have to run at a higher rate of speed to produce the required amount of refrigeration in a given time. It is hetter, therefore, to have too much piping in a cold storage room than too little, for the extra cost at the start will more than pay for itself in the end. To run the compressor much faster in order to carry a lower hack pressure to do the required amount of refrigeration, means a greater consumption of coal to operate the engine. If the amount of piping is sufficient, or even if there is excess, we can carry a higher back pressure, and as a consequence a greater amount of ammonia gas will be pumped back to the compressor and the work will be done fully as well and more economically.

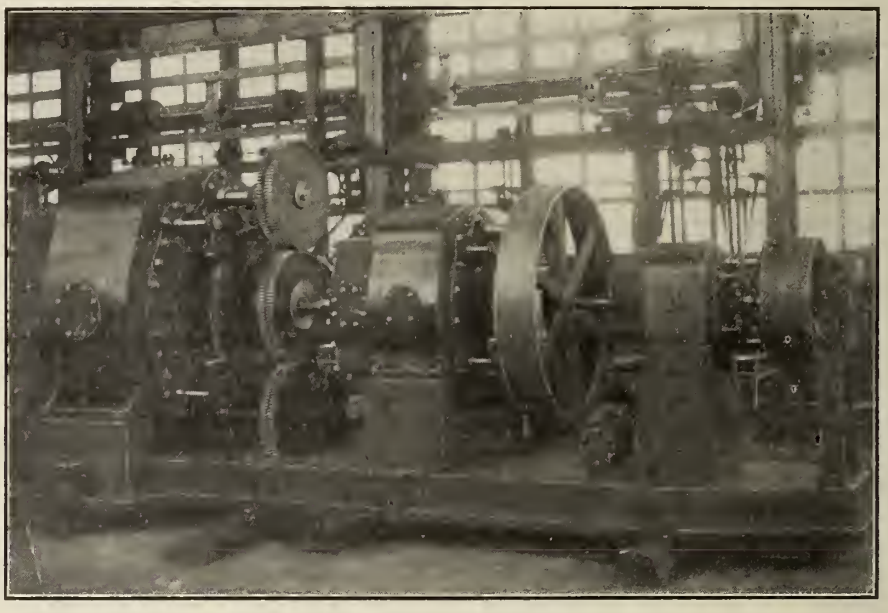
In summing up on mechanical refrigeration allow me to say that in the control and operation of the modern refrigeration plant, he it small or large, nothing can exceed, in favorable results, the personal care of an expert engineer, because automatic mechanisms are less important than the watchful attention of an able and experienced man. While this idea of the value of personality is perhaps true in all the arts and crafts, and always has been, it is particularly true in the manifold details necessary to successful mechanical refrigeration, owing to the varying and unique circumstances which distinguish the art of refrigeràtion and preservation.

THE HERCULES ROTARY STEAM ENGINE.

By George E. Fax.

THE "Hercules" rotary steam engine was huilt to the design and order of H. S. Call, and the illustration herewith shows the completed mechanism, just previous to shipment to Wetaskiwin, Alberta. The engine is arranged for triple expansion, and is designed to operate at a working pressure of 250 pounds per sq. inch, the steam being superheated 200 degs. Fah. A small steam reversing cylinder, similar to those used on marine engines of the reciprocating type is placed hetween the high and intermediate cylinders and connections are made hetween this cylinder and the controlling sleeves of each of the rotary cylinders hy suitable links. The lever which operates the valve on the reversing cylinder is mounted at the high pressure end, and hy this lever the operator may start, stop, or run the engine in either direction at any speed up to 200 revolutions per minute, when the governor responds and automatically controls any further increase of speed. An intercepting valve is placed in the steam line between the high and intermediate cylinders; a heavy over-load may thus he taken care of by admitting live steam to the latter. The levers are not shown as it was impossible to get a photograph of the engine from the operating side on account of the light.

The rotors, or revolving pistons are connected to each other hy shaft couplings hetween the cylinders, the shaft gradually stepping up in size from the high to the low pressure end, where the total driving power is taken to drive a water cooled prony brake mounted between separate hearings. This particular engine is equipped with a pulley for each cylinder so that a brake test may he taken from any one of the three cylinders independantly, hy removing the shaft couplings.



The "Hercules" Rotary Steam Engine, built by the John Inglis Co., Toronto.

Operating Principle and Construction.

The cylinder is eliptical in bore, with long diameter on horizontal centre line. It was bored by a special boring bar previously explained in the March, 1911, issue of Can. Machy. The steam valves at the top and bottom on the vertical centre line are geared from the main shaft, and revolve at the same revolutions per minute as the rotor, but in the opposite direction. Four exhaust valves and two steam valve reversing sleeves are shown which do not revolve but are connected to the reversing gear. Steam is admitted and exhausted through the ends of the valves. The steam valves are constructed in two sections, an inner and outer sleeve. The inner sleeve contains the cut-off blocks which are controlled by the governor on the high pressure cylinder only; the intermediate and low pressure cylinders having hand adjustments. The rotor which is circular and equal to the small cylinder diameter contains two oscillating hlades, the ends of which are always in contact with the cylinder wall at any position in the revolution.

THE READERS' POINT OF VIEW

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

INTERNAL COMBUSTION ENGINES.

By A. F. White.

LAST month we discussed some of the fundamental principles of a gas engine. This paper deals exclusively with the ignition side of same.

Ignition, as every engine user knows, is one of the vitally important features of the gas or gasoline engine, whether the engine be at work in a factory, on a farm, in an automobile, motor boat or flying machine. Ignition is absolutely essential to the successful operation of the machine. In the earlier stages of gas engine manufacture, the igniting methods used were a most fruitful source of annoyance and difficulty. One of the earliest and simplest forms of ignition is shown at Fig. 1; this is known as the "hot tube" method. The wrought

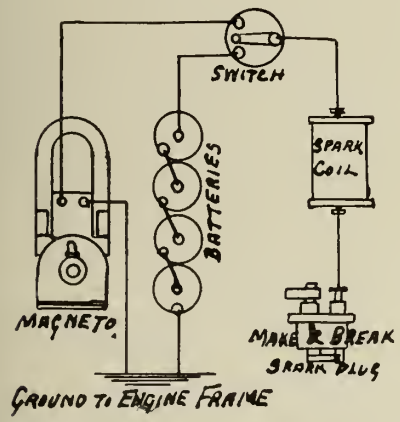


Fig. 3—Diagram of Jump Spark Ignition with Battery and Magneto.

iron tube, A, is closed at the upper end and communicates at its lower end through the port B, with the cylinder, C. It is heated by an external flame from the Bunsen burner, D, and is maintained at a full red heat. The chimney, E, around the tube, is lined with asbestos, which keeps the flame in good contact with the tube and prevents loss of heat. During the admission stroke, the tube is filled with products of combustion at atmospheric pressure remaining from the previous explosion. As the compression goes on, these non-explosive products of combustion are compressed into the upper part of the tube, while part of the explosive mixture from the cylinder comes in contact with the incandescent portion of the tube and is ignited. With this arrangement, the actual time of ignition is not very definite. Various other devices of timing valves have been used to overcome this latter difficulty, but they have all proved more or less troublesome, and this form of ignition has been practically abandoned owing to the superior advantage of electrical firing.

Timing of Ignition a Factor in Economical Operation.

Proper timing of ignition devices has a direct result upon the economical working of the engine. If ignition occurs too early on the compression stroke, combustion of the charge commences at or before the inner dead centre of the engine is reached, resulting in violent shocks and excessive strains upon the piston, connecting rod and crank, and

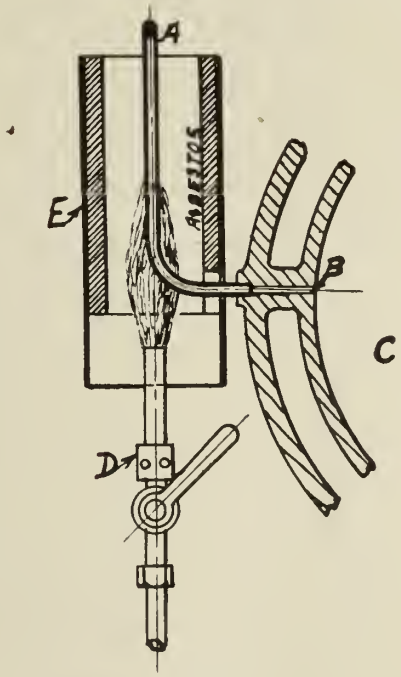


Fig. 1—Hot Tube Ignitor.

involving great waste of power. If ignition occurs too late, the piston has commenced to accelerate in consequence of the uniform velocity of the crank, so that the explosive force follows the piston without attaining its maximum thrusting effort, and probably with some loss of compression pressure, due to the partial re-expansion of the charge before ignition is effected.

Electric ignition permits accurate timing; it can be controlled at will, being retarded or accelerated instantly to maintain the utmost power from either slow or quick burning gas mixtures. It brings the spark inside the combustion chamber and gives quicker effect than when ignition commences inside a hot tube. There is also a further advantage in being able to start up at once without having to wait for the tube to become heated.

Types of Electrical Ignition.

There are two distinct types of electrical ignition whereby sparks are pro-

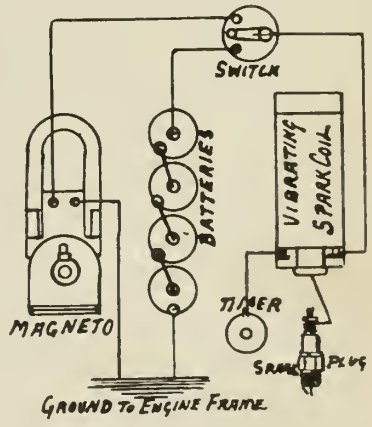


Fig. 2—Diagram of Make and Break Ignition

duced—one known as the make and break system and the other as the jump spark or high tension system. In the make and break system, a diagram of which is shown at Fig. 2, the spark is caused by separating the two contact points through which a current has been flowing; an electric arc will then pass between the separated contact points. In order to ensure that the temperature of the arc is high enough and its duration is sufficient to ignite the explosive mixture through which it passes, a spark coil has to be inserted in the wiring current . A spark coil consists merely of a bundle of soft iron wires, surrounded by a coil of insulated copper wire,

through which the current passes. The contact points of the ignition must be brought together to re-establish the current before another spark can be obtained.

In the jump spark method, the terminals are stationary, generally about 1-16 of an inch apart, and the spark is made to spring across the gap between them by putting the terminals in the secondary circuit of an induction coil. This coil consists of a core of soft iron wire around which is wound a relatively coarse insulating wire, "the primary

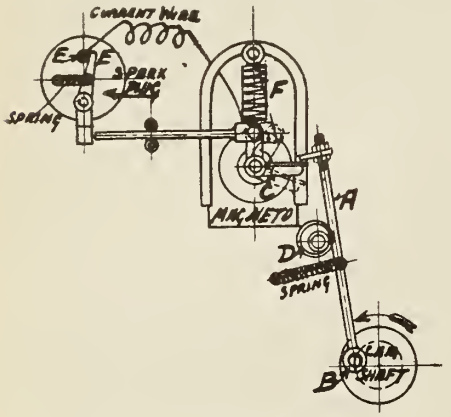


Fig. 4—Diagram of Low Tension Ignition with Oscillating Magneto.

circuit," from it the source of energy flows. A relatively fine insulated wire coil, "the secondary circuit," is wound around the primary coil, but has no metallic contact with it. If the current flowing through the primary circuit is varied in strength it creates or induces a current in the secondary circuit. The coil is usually provided with a magnetic vibrator similar to that used on an electric bell, which makes and breaks the primary circuit with great rapidity and induces a considerable alternating current in the secondary circuit and a series of sparks at the gap or the plug. This system has the great advantage of not having any movable parts in the engine cylinder. A diagram of a jump spark circuit is shown at Fig. 3. The current is usually supplied by batteries or dry cells for small engines, while on larger engines it is customary to start only from batteries and generate the current after starting from a magneto, which is driven direct from the engine. High tension magneto ignition has of late years been brought to such a high state of perfection that to-day it is the standard ignition for all automobile and marine engines.

The low tension oscillating magneto is becoming the standard practice for stationary gas engine work. This magneto produces intermittent impulses of current when the armature is oscillated by some form of trip gear. This system has a distinct advantage over any other form of electric ignition, as there is only one single wire connection required between the magneto and the engine, also the spark produced is as intense when starting slowly as when running at full speed, therefore obviating the necessity of a battery and coil for starting purposes.

There are a number of different methods of operating the above. Fig. 4 illustrates a very simple arrangement and one which gives good satisfaction. The trip rod, A, is operated by the crank B, and engages with the arm C, on the magneto armature spindle, disengaging at the firing point. This latter is determined by the timer D, consisting of a roller working on an eccentric pin, which can be adjusted to suit requirements, being either advanced or retarded. When the trip rod A disengages with the arm C, the spring F quickly returns the armature, thus generating an electric current and at the same time separating the electrodes EE, causing a bright spark to appear at the points of contact.

A SIMPLE CONDENSER

By James E. Noble, Toronto.

THE cut shows a simple and efficient condenser, heater, oil separator and hot well arrangement, which can be used to advantage in connection with the power plants of hotels, public institutions, etc. This method of utilizing exhaust steam has some novel features and is well worth notice.

Referring to the cut, tank A contains clean water which may be used for cooking, hot drinks, or other purposes. In this tank is a condensing coil, through which the condensed steam passes to tank B or hot well. The exhaust pipe C of a small steam engine is connected

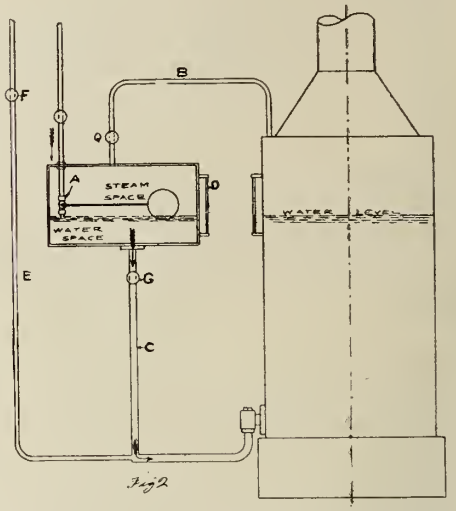
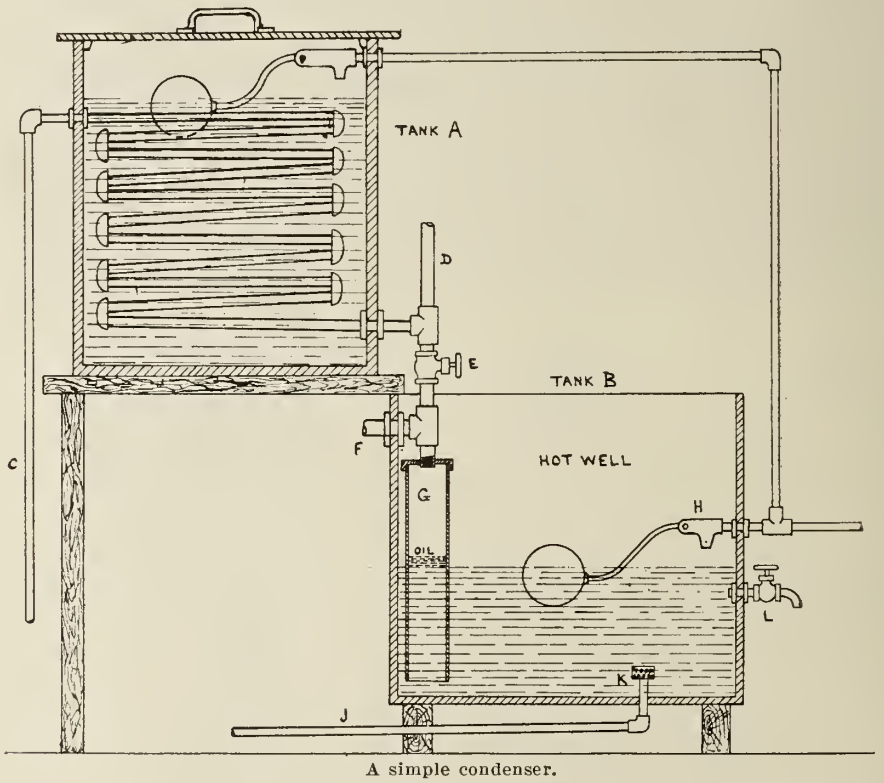


Fig. 2—Automatic Boiler Feed Arrangement.

to the condensing coil in tank A; D is open to the atmosphere, E is a valve to regulate the drip, F is the overflow, and G a piece of large pipe—say 4 or 5 inches diameter, reaching nearly to the bottom of tank B. At H, is seen the ball valve which controls the flow of city water and maintains a constant water level in tank B. Another ball valve acts similarly in tank A. The suction pipe of the boiler feed pump is shown at J, and K is a strainer. The oil brought over with the condensed steam is trapped in pipe G and floats on the top of the water there. It is the



A simple condenser.

duty of the engineer, onee a day, to hold down the ball valve in tank B until the latter overflows at F, thus carrying off the oil. Should oil at any time escape into tank B, it can be got rid of by lowering the water level a few inches by means of valve L. Tank A is of course fitted with a valve, not shown, for drawing off the hot water as required. This demand is generally fairly continuous, so that practically all the steam is condensed in the coil and tank B receives nothing but hot water.

AUTOMATIC BOILER FEED ARRANGEMENT.

By O. G. A. Pettersson, King Edward, Man.

THE following is a description of automatic boiler feeding devices that were tried on a vertical three flue boiler of 15 lbs. pressure, burning about 2½ tons of coal and upwards, per day of 16 working hours ; the steam being used for radiators, hot ovens, etc. The idea aimed at, was for three dish washers to do the stoking between them, and have the city water maintain the proper water level, the supply coming by gravity from tanks situated on the 7th storey. The first arrangement, fig. 1, consisted of a float, which was supposed to remain at the water level. It was connected by a copper wire, chain and weighted lever to a plug cock, so that it turned the feed off or on as required. Such a device is by no means uncommon, it having been operated successfully on hundreds of blast furnace boilers. In this case, although used for several years, it was never really satisfactory, because there was not enough room for a decent sized float, and as the boiler was forced pretty heavily at certain periods of the day, the maximum and minimum allowable water level showed a very small variation. Again, the feed water deposited a lot of scale, some of which settled on the float, causing it to sink lower down, with the consequence that after a time it would feed too much water. The plug feed cock used to leak and wanted screwing up every now and then, the latter being always rather a ticklish operation, due to its liability to stick.

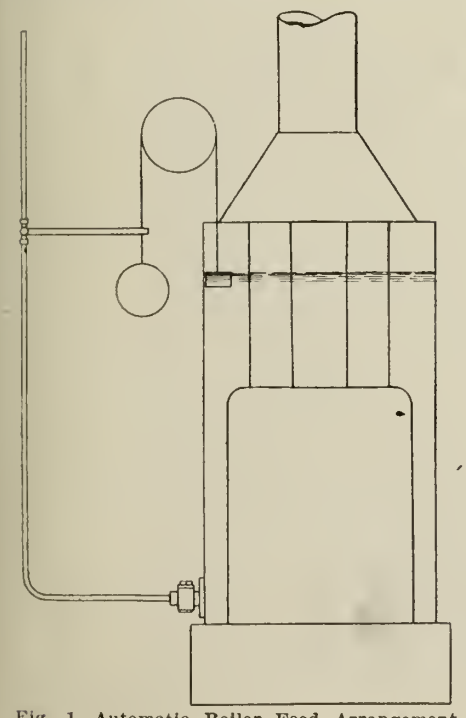


Fig. 1—Automatic Boiler Feed Arrangement.

The next plan was to have the feed controlled by the ball cock A, fig. 2, and as there was very little room in the boiler, it was placed in a rectangular box fastened on the wall, so that the water could be maintained at the same level as in the boiler. The box was connected to the steam and water spaces of the boiler by pipes B and C, a gauge glass D being also fitted. A bye-pass pipe E, enabled the boiler to be fed by hand, if the automatic arrangement failed. This was accomplished by opening valve F and closing valve G. The ball cock A was placed in the box and discharged the feed water into the tank, from which it flowed into the boiler through the pipe C. The same water level was expected to be kept in the tank as in the boiler and the ball cock would open and close with any fluctuation. From the first, it was a failure ; the tank would fill up quickly enough and the ball cock would shut off the feed. It would then slowly lower and begin to feed again, but meanwhile the boiler would be getting short of water. Whether it was sluggish circulation, or steam condensing because of the freshly admitted cold water and so helping to keep the water level up in the tank, was not definitely settled ; in any case, it was found to be unsatisfactory.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

The next arrangement was to have the ball cock feed pipe H go straight through the tank as in fig. 3, then into the boiler without mixing with the tank water. This arrangement got to work well, after various little defects had been overcome. The first trouble was with the copper float. This crumpled up as soon as put into service, through not being strong enough for the pressure. The lever was also found to be rather too short, therefore a larger tank with a longer lever was ordered, and a larger float put in. The feed pipes were found to rust up owing to the city water being got from a different source. This was overcome by fitting plugs in as many of the elbows as possible, unions being put here and there, to make easy to take down most of the pipes for cleaning purposes. A bye-pass pipe J was also fitted, for hand feeding as before, so that the tank and ball cock could be cleaned and adjusted, without having to shut the boiler down. The feed from the ball cock went to the bottom of the boiler as before, through pipe K, and the tank was connected by pipe L to the middle of the boiler.

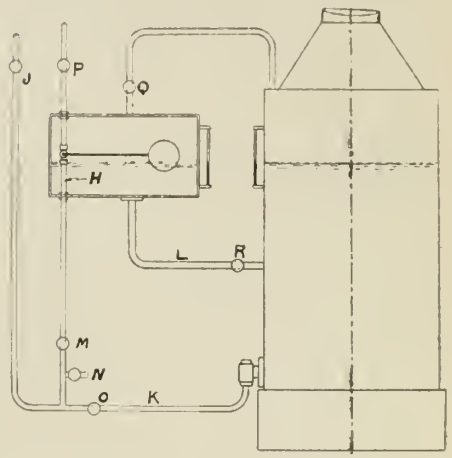


Fig. 3—Automatic Boiler Feed Arrangement.

To indicate whether the ball cock was working properly or not, valves M, N, O, were fitted. On opening N, which was simply a ¾ inch tap plug, the water would shoot out with considerable force, if the ball cock was feeding. If not feeding properly, or if the pipes were getting stopped-up, the water would come out with less force. To test if the boiler check valve was leaking, it was only necessary to shut valve M, and open N, and to test if the city water was feeding properly, M, was shut and N opened.

The advantages of this method of boiler feed are obvious. The feeding arrangements, being all external, can be examined and adjusted at anytime, without having to shut the boiler down, as is necessary if the ball cock is fitted inside.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

ENGINE LUBRICATING SYSTEMS.

By Bellfield.

PRACTICALLY all engineers now realize the economy in oil and steam due to the use of an efficient lubricating system on their engines and auxiliaries. For some time, engines in the large railway and lighting power plants have been provided with automatic systems for bearing lubrication. These systems are usually of the central type, in which oil is supplied from a central source and passed through pipes to all of the bearings on the different power units and their auxiliaries. The drips from the bearings are collected and returned to a large central filtering plant and after impurities are removed, the oil is recirculated. While this system is admirably suited to large stations, it is not so well adapted to the ordinary small isolated plant, because too expensive, and the amount of piping required (a large proportion of which has to be in duplicate, to insure reliable operation) is undesirable.

In order that small plants may have the benefit of scientific lubrication, the Richardson-Phenix Co. has designed, and are now manufacturing an individual oiling system. The advantages of this system is that all of the various pipes receivers, filters, pumps, etc., can be

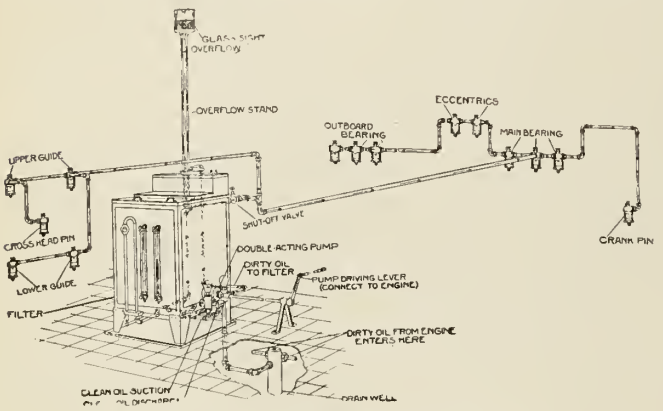


Fig. 1.—Apparatus necessary for a Richardson Oiling and Filtering System for an engine having 14 points of lubrication.

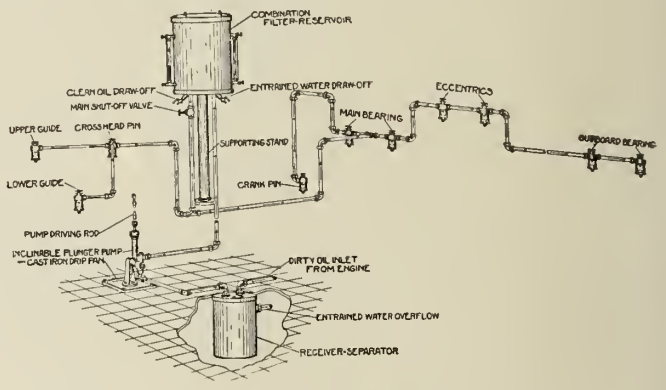
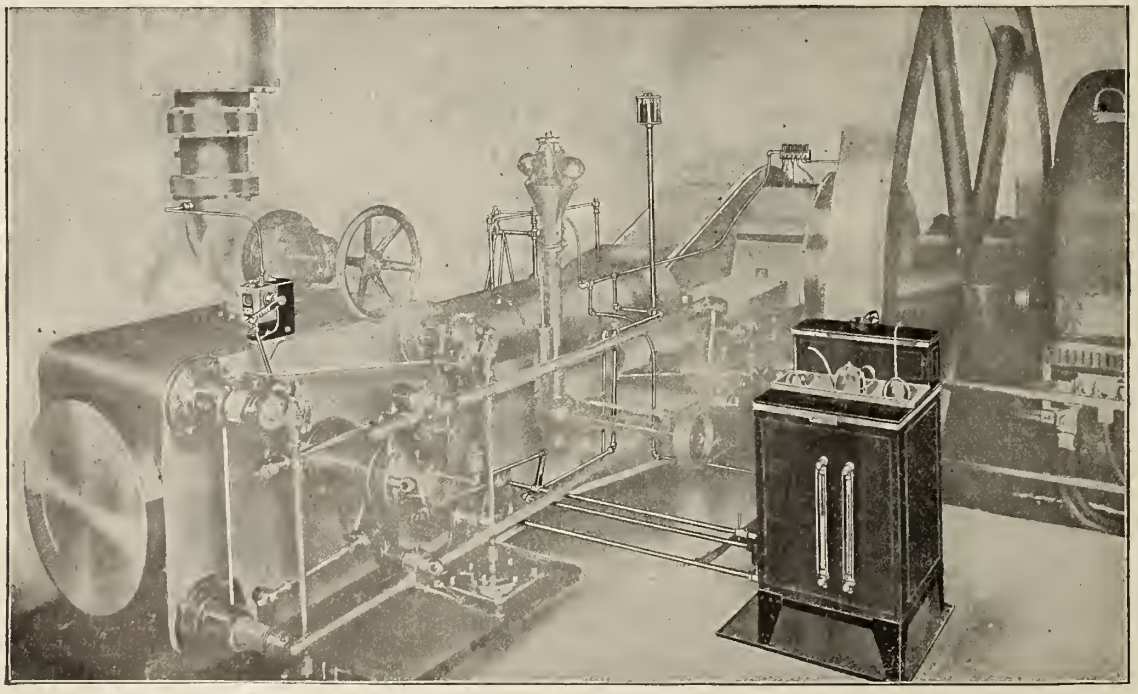


Fig. 2.—Diagramatical drawing of Phenix Individual Oiling and Filtering System, showing apparatus and material necessary for an engine having 10 points of lubrication.



Richardson Individual Oiling and Filtering System applied to a simple Corliss engine.

located on or close to the engine. While undoubtedly every engineer appreciates the advantages of continuous stream lubrication for bearings, it is probable that one reason why they have not come into more general use is due to the fact that if an engineer is to equip his engine with a lubrication system, he is forced to go into the open market and purchase his filters, pumps, piping, gang oilers and sight feeds, etc., independently. He has to practically design his own system, purchase the various elements and so attach them to his engine, that all will work together. The engineer is not always conversant with the best method of piping-up such a system, neither does he have a definite idea as to how much oil should be circulated through an engine of a given horse power per hour, and the size of filter and pump necessary. To obviate these difficulties and to make it easier for the engineer to equip his engines with automatic lubrication, the Richardson-Phenix Co. has now further prefected the individual automatic oiling system, so that they need only know the horse power of the engine, the type and make, to supply a system complete with all the necessary appurtenances, for ready attachment to the engine. By experimenting and carefully studying the standard designs turned out by the different engine manufacturers, they have perfected this individual oiling system to such a point that an engineer will have little difficulty in putting it together and having it operate satisfactorily.

Two Lubricating Systems Embraced.

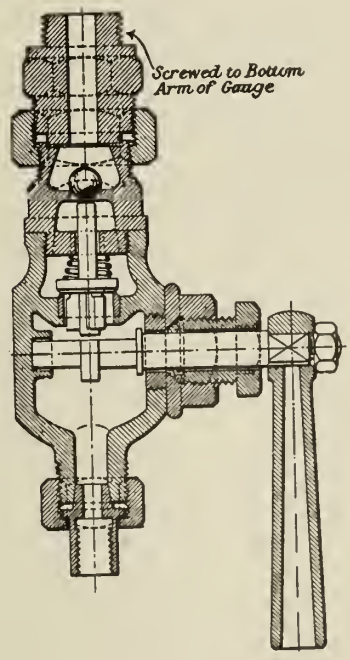
Two standard systems are now being built. Fig. 1 is known as the Richardson System, and that in Fig. 2 as the Phenix System, The first is more desirable for large Corliss engines, and is furnished in units for lubricating engines of 100 to 1,500 h.p., and in sizes having an oil filtering capacity of from 4 to 35 gallons per hour. The second is built for engines of from 10 to 200 h.p., and in sizes having a filtering capacity of from 1 to 4 gallons per hour. While the essential parts of the two are identical, they differ somewhat in detail. Briefly, their operation is as follows :— Used oil from the various points of lubrication is collected in a suitable receptacle located at some point, so that the oil flows into it by gravity; then a pump elevates the dirty oil to the top of the filter. After having all impurities and entrained water removed by the filter, the oil either flows by gravity or is forced by a pump to the various points of lubrication. At each point of lubrication a sight feed oiler is provided, by means of which the amount of oil fed to that bearing can be accurately adjusted, independent of the amount of oil supplied to all of the other bearings. The gauge glass in each feed enables the attendant to see just exactly how much oil is to be fed.

These individual systems are designed as a unit; all parts fit in together and operate satisfactorily. The filter and pump have the right capacity for the number of feeds, and the proper amount of piping is supplied for each type of engine. In connecting up, all troublesome pipe fitting is eliminated by the use of novel devices known as "Union Cinch Fittings."

It is claimed that these systems will reduce the steam consumption of engines by 2 to 20 per cent over that necessary when the old-fashioned hand oiling method is relied upon. It has been figured out that in any size engine, a reduction of 2 per cent. in the steam consumption, due to the reduction of power consuming friction, will pay for necessary oiling systems in the amount of steam saved alone inside of one year. It is also claimed that these systems will reduce the oil consumption anywhere from 40 to 75 per cent. The Richardson-Phenix Co., Milwaukee, Wis., are manufacturers of these two sets of apparatus.

SHELTERED TRYCOCK FOR GAUGE-GLASSES.

THE illustration shows a new form of trycock for gauge-glass, which is being introduced by J. Hopkinson & Co., Britannia Works, Huddersfield, England. The idea underlying the arrangement of the cock has had other applications than that here shown, but the particular example of it which the cock embodies is both interesting and neat. Although, in accordance with current nomenclature, the fitting is described as a cock, it will be at once noted from the figure that it is in essence a valve. The main feature of the design has reference to the fact that the mushroom valve of the fitting, which forms the valve proper, is backed up and sheltered by a ball-valve above it, and that the operating mechanism is constructed to lift the mushroom valve before the ball-valve. The idea of construction is that as the mushroom valve is always open before steam or water reaches it, when the cock is being used to blow through, it is protected from the cutting action which takes place on an opening valve with pressure behind, so that it remains always tight. Any cutting action which occurs will, of course, be transferred to the ball-valve, but this is of little importance, since this valve is in series with the lower one. In any case, it is obviously better that the cutting should take place on a subsidiary rather than on a main valve.



Sheltered trycock for gauge glasses.

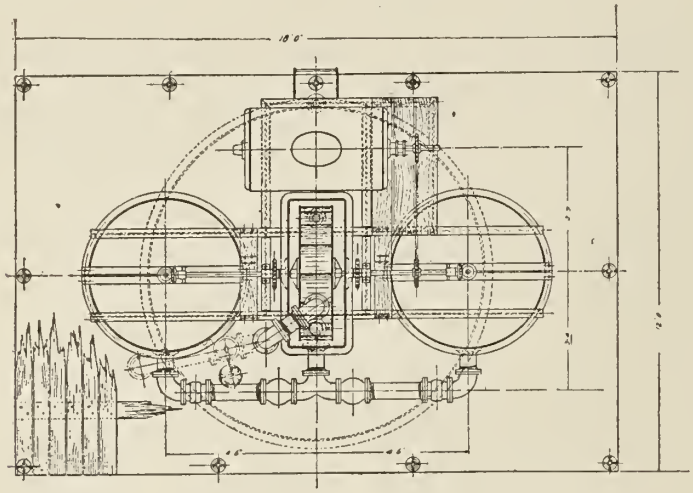
The details of the cock require little description, as they are well shown in the illustration. The mushroom valve, which is made of Platnam metal, is formed with upper and lower projecting studs, the lower of which is acted on by an eccentric carried by a horizontal spindle, and lifted when the spindle is rotated by its handle. The upper stud on rising, owing to the lifting of the valve, comes in contact with the ball-valve, and opens that in turn. There is a clearance between the top stud and the ball to allow the mushroom valve to open before the ball is acted on. The valve has a controlling spiral spring above it, as shown.

AN AUTOMATIC WATER PURIFYSYSTEM.

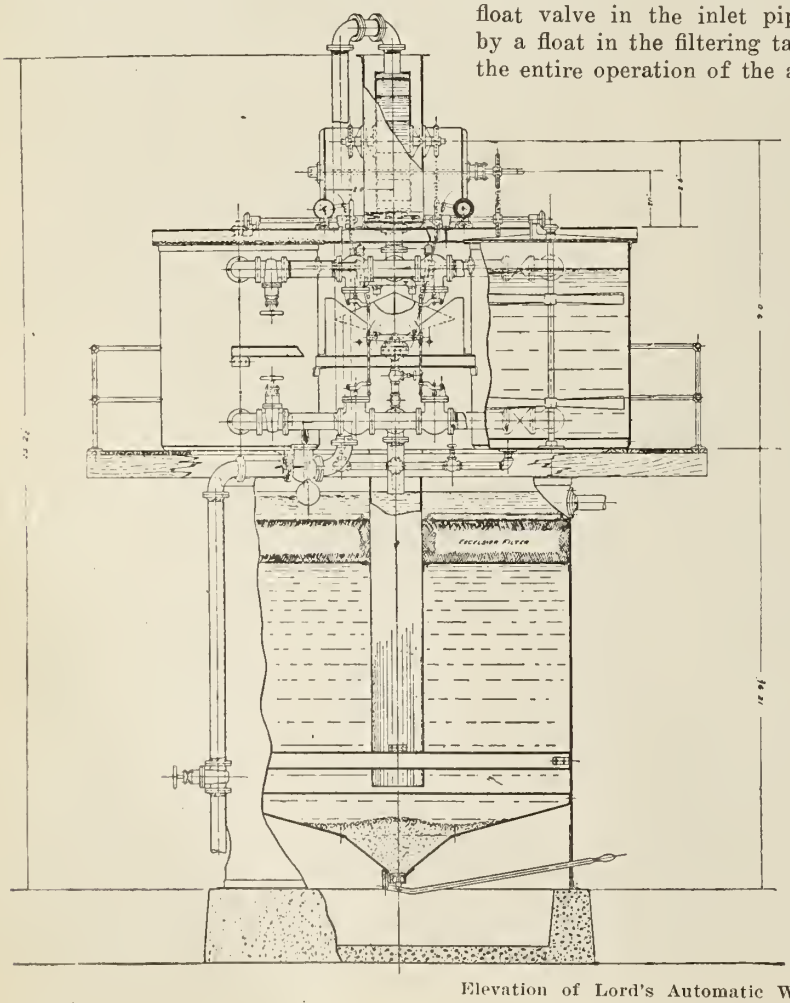
THE purification of water for boiler feed and industrial purposes is highly essential in most plants. There are numerous machines and devices on the market for this purpose, and the selection of one for any particular case is largely a matter of the cost to install and operate same.

The George W. Lord Co., Philadelphio, Pa., has recently put on the market an apparatus for water purifying which is entirely automatic in its operation, and which may be installed for a comparatively moderate price. The apparatus consists principally of one large settling and filtering tank, two mixing tanks, one chemical storage tank and two measuring chambers. The incoming water first passes over a waterwheel which furnishes the power to operate paddles in the mixing and chemical storage tanks. From the wheel, the water flows to either one or other of the two mixing tanks, directly below where it comes in contact with the chemicals flowing by gravity from the chemical storage tank. The solu-

tion of chemicals is measured out by an automatic measuring valve and the speed of operation varies with the flow of the water. Hence, the correct amount of chemicals is mixed with the water no matter what the rate of flow may be. From the mixing tanks, the water flows to the bottom of the settling and filter tank through a large cylindrical tube, where it drops the bulk of the precipitates formed, into the cone-shaped hopper bottom of the tank. These precipitates can be removed by a sludge valve designed for the purpose. The water then rises, and after passing through an excelsior filter near the top of the tank flows off through the outlet pipe at the top. The inlet and outlet pipes of the two mixing tanks are controlled by lever valves, which are automatically operated so as to cause the water to flow first into one and then into the other of the tanks. These valves as well as the chemical measuring valve are operated by means of sets of levers which are shifted by a dumping bucket, the latter operated by the weight of water run in from overflow pipes. A float valve in the inlet pipe, operated by a float in the filtering tank, controls the entire operation of the apparatus.



Plan of Lord's Automatic Water Purifying System.

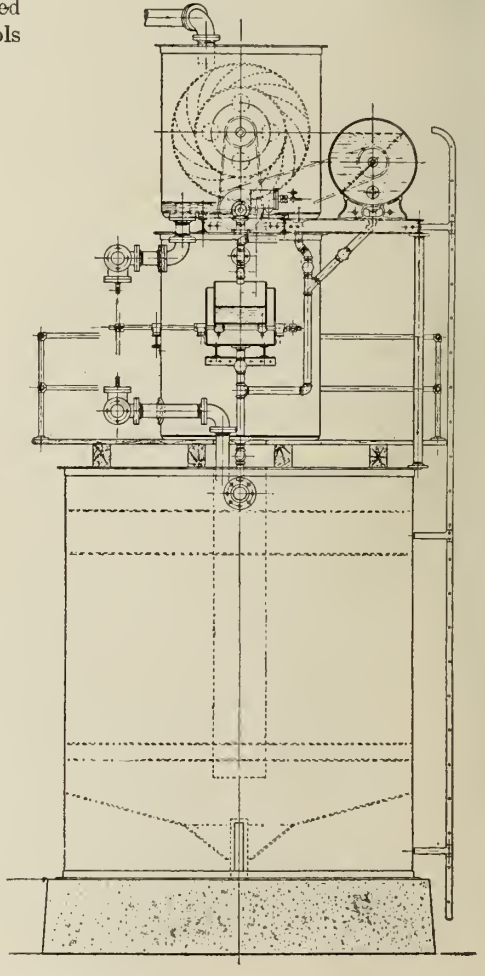


Elevation of Lord's Automatic Water Purifying System.

METALLIC GASKETS.

THE accompanying illustration serves to show one form of the patent metallic gaskets being manufactured at Bridgeburg, Ont., by the Canadian Gasket Co. This concern has secured the Canadian patent rights on a varied line of gaskets required for steam, gas, oil, ammonia, water and other purposes.

They may be had suitable for boiler, manhole and handhole doors, pipe joints and other similar connections, and are claimed to be not only reversible and interchangeable, but may be used again



and again. Ease of application together with absolutely tight joints, under large variations of pressure and temperature, are further advantages included in their make-up and service record. They are made corrugated in either copper or steel, have asbestos cord filling for the grooves, and are of standard or special sizes as required.

HINTS TO BOILER ATTENDANTS.*

Getting up Steam.—See that there is sufficient water in the boiler before the fire is lighted. Do not force the fire when getting up steam, but let it burn slowly, so as to heat the boiler gradually. If the water is cold take not less than about three hours to raise steam in a small boiler and twice as long in a large one. If for special reasons it is necessary to hurry, less time may be allowed, but if steam is raised too quickly, the boiler will be strained and wear out rapidly.

Stoking.—When stoking, do it quickly and regularly, and keep the firebars evenly and well covered. Throw the coal only where it is required. Do not use the rake unless the coal cakes considerably, and the fire cannot be kept level without it. Keep the fire-doors open as short a time as possible. Never allow the bars to become bare. If too much cold air gets in, less steam will be raised, and the fuel will be wasted.

Cleaning the Fire.—Clean the fire when there is much accumulation of clinker. When cleaning the fire, do it quickly. Do not let ashes accumulate in the bottom of the furnace. Remove the clinker and ashes from the ashpit, and take them well away from the boiler before putting water on to cool them. Wetting the front of the boiler causes the plates to rust.

Feeding the Boiler.—Keep the water level about seven inches above the top of the fire-box or tubes. If there is too little water, an explosion may happen, and if there is too much, the boiler will prime, and water will go out at the safety-valves, or get into the engine cylinders. Keep the water in the glass about halfway up; and, even when blowing down to freshen the water, never let it get less than about two inches high in the glass.

Shortness of Water.—Shortness of water can generally be prevented by paying proper attention to the glass water gauge, test cocks, and feed. If it is known that the water is low, but not low enough to cause the plates or tubes to get too hot, throw wet ashes on the fire to damp it, until the water has got to its proper height again, and shut the dampers. If the water has got so low that the plates get too hot, draw the fires and ease the safety-valves. The damper in all cases of shortness of water should be immediately closed. The furnace door may be opened to stop the draught, but only when the water is very low or when there is no damper. Do not put water into the boiler when the plates are red-hot.

Glass Water Gauge and Test Cocks.—Watch the glass water gauge, frequently blow it through, and keep the cocks attached to it in working order. The cocks between the top and bottom of the water gauge and the boiler must always be kept open, except when being tested, for if either of them is shut a wrong water-level will be shown in the glass. Open the test cocks (of which there should be three) frequently, so as to test the height of water, and keep the cocks clear. When the water level is about half-way up the glass, steam should come out of the top cock when a test is made, steam and water mixed out of the middle one, and water out of the bottom one. If these points are not attended to, the boiler will be liable to be damaged, and an explosion may take place.

Safety Valves.—Lift the safety-valves every day before steam is raised and see that they are in free working order. Slightly ease the valves occasionally during each day. See that the drain-pipe is clear, and that no water is in the casing. Do not place extra weights on the safety-valves. If the valves leak badly, they can generally be made tight enough by grinding-in with a little fine sand, when steam is down. If the valves are extra loaded an explosion is likely to take place, and even if an explosion does not take place, the person who puts too much weight on them is liable to be punished.

Blow-off and Scum Cocks.—Work the blow-off and scum cocks at least twice a day, so as to keep them in working order. Blow about half an inch or an inch of water down on each occasion. Use the blow-off cock when the engine is standing and the scum cock as much as necessary when the engine is working.

Emptying the Boiler.—Do not draw the fire, but allow it to burn out, and keep the fire-door and damper shut until the fire is burnt out. Do not empty the boiler by blowing the water out, but let it cool with the water in; the water can afterwards, if necessary, be run or pumped out. The steam may be very gradually blown off at the safety-valves, and, if necessary, the man-hole door may afterwards be taken off to cool the boiler. Do not take the mud-hole doors off until the boiler is cool. Do not put cold water into the boiler to cool it, either by running-it-up or by pumping. If sufficient time cannot be allowed for the fire to burn out and the boiler to cool down before it is emptied, the fire may be drawn and the water blown out of the boiler, but the latter should not be done until the furnace plates, bars and bridges have had time to cool and the steam pressure has been reduced to 50 lbs. per square inch or less. It is better not to blow out quite all the water, but to leave a little in the boiler bottom which can be run or pumped out when cool.

Throwing Water into the Ashpit.—Do not throw water into the ashpit or bottom of the furnace to cool the ashes.

Cleaning the Boiler.—Clean the boiler every few weeks. Clean all the internal parts of the boiler well and free them from scale and dirt, more particularly the heating surfaces, the parts between the rivets, and where there is a double thickness of plate; also the cross tubes, if fitted. The external surfaces of the boiler in the fire-box, uptake, etc., require to be swept clear of soot, and the exposed outside of the shell should be kept clean and painted with red-lead.

Leakage from Mountings, Fittings, etc.—No water should be allowed to drip on the boiler, either from the boiler mountings, fittings, casing, or elsewhere. If water drips on the boiler it will rust the plates.

Preparation for Entire Examination.—When the boiler is to be thoroughly examined, take care that it is cool and well cleaned, both internally and externally. If this is not attended to, a proper examination cannot be made of parts not cleaned. Defects, such as cracks, buckling, or blisters, will be overlooked if all is not cleaned, and when steam is got up the boiler may leak or burst.

Examination of Fire-box and Stays. The fire-box or furnace should be carefully examined very frequently, and gauged to see that it is not becoming oval, as it is very unsafe to work an oval furnace at the same pressure as a round one of the same diameter; the crown of the furnace should also be particularly examined, so as to detect any cracks, bulging, etc. A furnace which is much bulged, or whose crown has come down should not be worked, as it is liable to give way suddenly, when all persons standing near would probably be killed or at least badly scalded. All the stays and their attachments should be carefully examined, and if they are found defective, they should be put right. When they are found to be much corroded and wasted they should be removed and renewed before steam is again got up. If necessary, the boiler may possibly be worked for a short time at a considerably reduced pressure, and the safety valves adjusted to suit.

*Extracts from Board of Trade publications.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

Kamloops.—By-laws to raise $240,000 for the construction of the Barrier River hydro-electric power plant, and $60,000 for the improvement and extension of the city waterworks will be submitted to the ratepayers.

Vernon.—Fire broke out recently in the upper part of the power house, and despite the efforts of the fire brigade, the building, which was a wooden structure, was almost entirely consumed. The flames, however, were kept partly under control, and the machinery does not appear to have been greatly damaged. The loss was fully covered by insurance, and beyond the inconvenience of being without lights for a few nights, the city will not be the loser to any great extent. So well were the flames kept away from the machinery that the paint on the engine was not even blistered. The plant was in operation again within the next few days. The origin of the fire is unknown.

Vancouver.—The following are the recommendations of Fire Chief Carlisle for 1912: Four hose wagons, $26,000; two city service trucks, $26,000; one water tower, $14,000; three pumping engines, $42,000; one life boat, $125,000; one pumping station with pipe around False Creek, $150,000; salvage wagon and equipment, $7,000. Three new stations are also recommended.

ALBERTA.

Edmonton.—It is proposed to select a consulting gas engineer who will supervise the construction of the gas plant, prepare plans and estimates, and see the plant in actual satisfactory operation turning out commercial gas. A gas superintendent to handle the department will then be found to take permanent charge of the new utility. It is considered that an expert necessary for the designing and constructing of the plant will he too expensive a man to retain as superintendent at all times.

Macleod.—The most important action taken by the town council at its regular meeting was the passage of a motion reducing the price of electric light from 15 cents per K.W. hour to 13 cents, as recommended by Superintendent Altham in bis annual report.

Edmonton.—Another 2,000 kilowatt turbine generator (alternating current), and one 750 kilowatt generator, direct current, constitutes the machinery that it is proposed to add to the power plant during the year 1912. This means that at this time it is found necessary to duplicate the capacity of the 2,000 kilowatt turbine generator now being installed, which machine was declared less than a year ago to be unnecessarily large by some members of the commission board at that time. The superintendent of the power plant is communicating with manufacturers of electrical machinery, asking them to be prepared to give figures on bids to he called for in the near future. The 2,000 kilowatt machine is to be an alternating current high pressure turbine, 2,200 volts, three phase, 60 cycle, and in order to utilize its current for street railway purposes a rotary converter or motor generator set would also he required. To obviate the installation of either, the purchase of a 750 kilowatt, direct current generator is contemplated. This will represent the largest piece of direct current producing machinery at the power plant. 400 kilowatt being the largest meantime. Provision for these two machines will be incorporated in the estimates for 1912. Aside from this electrical machinery, which it is purposed to procure for the power plant, the street railway superintendent is recommending the purchase of one or two rotary converters to he stationed at some point along the street railway line.

SASKATCHEWAN.

Yorkton.—An increase in the size of the electrical plant will soon be necessary as it is certain that with the coming summer there will be a large number of new consumers. Mr. Ingles was instructed to supply the council with full particulars as to cost, etc., of the necessary additional equipment.

Regina.—The importance of installing a municipally owned ,gas plant without delay, will be impressed upon the civic fathers by F. J. James and C. O. Hodgkins, representatives of the Board of Trade, within the near future. The Board of Trade has decided that it would be advisable to install a gas plant, and bave therefore taken steps toward securing the fulfilment of their aims.

The city council has already made provision for a gas plant, but as yet have not decided to install same. The sum of $20,000 has been reserved by them for investigation purposes as to the need of such a plant, and the cost of installation, but the council may use the money for other purposes if it so desires.

ONTARIO.

Toronto.—As the result of tbe success of the Hydro-Electric power by-law in tbe various municipalities of the province on New Year's Day, Hon. Adam Beck announces that $30,000,000 will be spent in the next two years, and a system established tbat will be complete from Sarnia on the west, to Cornwall and Ottawa on the east.

London.—The city of London Water Commissioners plan a new waterworks repair shop to cost $10,000. Official in charge, Supt. Glaubitz. It will be of brick construction and fully equipped with macbinery for making repairs.

Welland.—The transformer bouse of the M. C. R., just east of the new canal bridge, used for the purpose of generating power to swing the structure, was badly damaged by fire recently. The loss is estimated to be between eight and ten thousand dollars. Fortunately the power house is not needed at this time of the year, as navigation is closed. It was in the interior tbat the fire did the most damage. A quantity of valuable machinery and nearly all of the costly electrical equipment was ruined by fire and water. The cause of the fire is believed to have been due to a short circuit.

Owen Sound.—Machinery is required for the saw and planing mill of John Harrison & Sons Co. Two boilers of 100 pounds steam pressure, and 66 in. x 14 ft., a filing room outfit for 12-in. double cutting band saws, and one log jack and chain are included.

Galt.—Tenders will be called for a 250 k.v.a., 2,200 volts motor, direct connected to centrifugal pump. Specifications prepared by Hydro-Electric Commission, Toronto.

Sault Ste. Marie.—The Lake Superior Power Co. have awarded the contract to Chapman & Walker, Toronto, for the supply of electric motors, amounting to 3,000 h.p., and costing $30,000.

Carleton Place.—On January 1st a by-law to raise $200,000 for a waterworks system was voted on.

Kincardine.—An extension to the filtration system is proposed, and the engineer is instructed to report on present system and cause of scarcity of water.

Ottawa.—A by-law will he submitted to endorse an expenditure of $2,300,000 to bring water from McGregor's Lake.

Ottawa.—An artificial ice plant is to be installed in connection with the Chateau Laurier before the building is completed. The plant will he situated in the rear of the Grand Trunk station and will provide ice for both the station and the hotel. The architects, Ross & MacFarlane, say that the plant will be ready for operation as soon as the botel is completed.

Waterdown.—The by-law to provide $5,000 to instal a Hydro-Electric power plant has been passed by the ratepayers.

Brampton.—It bas been left to the ratepayers to decide wbether or not the town will purchase the electric ligbt and power interests of John McMurchy, for the sum of $15,000.

Paris.—It is proposed to expend $25,000 to instal Hydro-Electric power here.

Petrolea.—$6,000 will be spent to complete the Hydro-Electric system.

Port Credit.—The ratepayers are being asked to sanction an expenditure of $7,500 to complete tbe Hydro-Electric power plant.

Tillsonburg.—The ratepayers are being asked to provide $6,000 to complete the Hydro-Electric system.

Forest.—It is proposed to expend $20,000 on an electric light plant.

Toronto.—Toronto has plans calling for an expenditure of $2,200,000 to complete the Hydro-Electric system.

Richmond Hill.—Steps are being taken to provide $5,000 for electric lighting purposes.

Renfrew.—It is proposed to expend $60,000 for power extensions, etc.

Woodstock.—The ratepayers are being asked to provide $10,000 for lighting purposes.

QUEBEC.

Montreal.—The contract for the installation of the first two units for the development and transmission to Montreal of 40,000 h.p. of electrical energy from Carillon Falls has been given to the Carillon Construction & Development Co., Montreal, by the National Hydro-Electric Co. The work of this contract began on November 20th.

Montreal.—Tbe Bishop Construction Co., Montreal, has been awarded the contract for the construction of the dam power house of the hydro-electric power plant on the Magog River at a cost of $125,000. T. Pringle & Son, Ltd., engineers and architects, 419 Coristine Bldg., Montreal.

Lake Megantic.—The Lake Megantic (Que.) Pulp Co. will buy turbine engines for a new nower plant to be built on the Chaudiere River, at Lake Megantic.

NEW BRUNSWICK.

Fredericton.—Plans for expropriation proceedings to secure flowage land at Eel River for the Eel River Light, Heat & Power Co., were filed with tbe Provincial Government recently, when Mr. J. C. Hartley, solicitor for the company, appeared before the executive council to seek permission to conduct the expropriation proceedings. The Eel River Light, Heat & Power Co. are preparing to complete tbe development of power at Eel River, and expect to be in the field in a comparatively short time, furnishing electricity for this city and other places, including the C. P. R. works at McAdam. Some negotiations regarding the latter proposition have already been in progress.

Edmundston.—The town of Edmundston recently inaugurated its electric plant, when Mayor A. Dugal, in tbe presence of the aldermen of the town and Pius Michaud, M.P., turned on the electric current. Tbe generating station for both the water and the electric plants with capacity of 750 h.p., is situated on Green River, ten miles north of Edmundston, and consists of a dam 400 feet long and 28 feet high, a power house with two sets of twin water wheels and two electric generators. It can supply sufficient power for water distribution and electric lighting to a population of at least 10,000 inhabitants. The streets are lighted with 150 tungsten lamps, each having a capacity of 65 candle power. The capacity of the steam pump is 700 gallons per minute, and that of the electric pump, 1,200 gallons to the minute. On the highest point of the town is located a steel stand pipe 35 feet in diameter and 50 feet high, having a capacity of 35,000 gallons, wbich gives a natural water pressure of 125 pounds. Forty-four bydrants for fire protection are distributed over the town.

NOVA SCOTIA.

Halifax.—Moirs, Ltd., Halifax, are to install a 200 h.p. Robb-Mumford internally fired

GREETING:

To our friends and customers we extend our hands in friendly, thankful greeting.

Without your kind co-operation this company would not be in existence.

But with your help we have just closed the best and most prosperous year in our career—hence our gratitude to you.

When we make a sale we endeavor to make a friend.

Never before in history did friendship play so big a part in business as it does to-day.

Commerce is based on confidence; and that we may be ever worthy of your esteem is our earnest wish. And so to you, our customers—the old and new, and those to be—we wish to say: Your interests are ours; and if we can help you solve some of your problems we will be glad. Our business is to serve.

We wish you for the New Year everything you wish for yourself.

The American Steam Gauge & Valve Manufacturing Co.

RALPH B. PHILLIPS, Treasurer and General Manager

BOSTON, MASS.

boiler, to be operated at 150 lbs. working pressure, and a 150 K.W. generator driven by a Robb-Armstrong automatic Corliss engiue of the side crank type. Both boiler and engine are to be used in a uew factory, being built at Halifax.

THE PARSONS TURBINE IN CANADA.

Mr. J. P. Stockbridge, who represents G. S. Parsons & Co., Newcastle-on-Type, is visiting various parts of Canada in the interests of their turbine which has such a wide application for driving generators, ventilating fans, etc. Mr. Stockbridge has recently been engaged in the installation of many large Parsons turbine plants iu Australia. One of the principal results of his present visit has been the placing of the sole Canadian agency for these turbines with the Robb Engiueering Co., who will also manufacture certain parts. The Robb Engineering Co., with offices in the principal cities of Canada, are the well-known contractors for the complete equipment of central power stations, collieries, steel works, etc.

THE E. B. EDDY CO. POWER PLANT EXTENSIONS.

Big improvements of the water powers at the E. B. Eddy Co. works at the Chaudiere Falls are contemplated. The power now driving the pulp and paper mills, saw mills, match factories, pail shops, etc., is the outcome of additions to the plant when reconstructed ten or twelve years ago after the Hull-Ottawa conflagration, and of a constantly growing business. It was not contemplated when the works were rehuilt in 1900, that the company's business would so rapidly increase, nor was it expected that the future requirements of power would he so great as has now become necessary, consequently, water wheels have been added from time to time in the most convenient locations without much regard to ultimate requirements, so long as the factories got the power quickly and where it was most needed at the time. The whole power system is now to be reconstructed so as to secure a central, constant supply of power for the needs of the company for the next quarter of a centnry or more.

Work has now hegun on the reconstruction of new reinforced steel concrete bulkheads and side walls to surround and deepen the present forebay ,and supply greater head and more water to the turbines. A power house of such height and strength as to utilize to the fullest extent, even at its highest floods, all the water flowing on the north side of the Ottawa River at the great Chaudiere is also being built. In this way there will be a general gain of 6 or 8 feet of water when the waters of the Ottawa are normal and the full head can also be had and used at the highest pitch of spring water. The present water wheels, some of which are obsolete, will be replaced by new wheels to take every advantage of the increased head. The hydro-electric plant will have three units of turbines and generators to develop 4,500 to 5,000 h.p. each, under normal conditions. These will be operated from one central station, thus the gain in power by utilizing the full head of the water under these improved conditions, will be from 50 to 60 per cent. over the present.

THE BRITISH COLUMBIA ELECTRIC RAILWAY CO.

On January 9, the management of the British Columbia Electric Railway Co. announced that awards had been made on tenders for the hydraulic and electrical equipment covering the proposed extension of the company's generating plant on the North Arm of Burrard Inlet. The plans for this undertaking represent an expenditure of approximately $1,000,000, and arrangements were made on the basis of completion of the installation during the present year. The company's present output at its North Arm plant is 43,500 h.p., which includes one unit of 10,500 h.p. placed in operation on January 8. It also has a steam auxiliary plant in Vancouver of 12,000 h.p., one unit of 3,000 h.p. at this station having heen put into service during the latter part of December.

The plans for the development of the hydro-electric plant on the North Arm, for which contracts were awarded as noted above, call for an additional installation of 42,000 h.p. at the point. This will give the company an available output of 85,500 h.p. from this station, which means the creation of a power station giving three times the amount of power furnished from any other similar plant in Western Canada. The company has also recently awarded contracts for the development of its steam auxiliary, making the plan available for an output of 20,000 h.p., and this work will he completed early this year. The combined power of its hydro-electric and steam plant which the company will have available at the close of 1912 is 105,000 h.p., or over one horse power for every two persons within the area of Greater Vancouver, the city which is the centre of the company's operations on the British Columbia mainland. Viewing the situation in another way, as the company's territory on the mainland is roughly 20x80 miles, provision will be made for 66 h.p. per square mile over the entire district.

In connectiou with the announcemeut, the company states that plans are now iu hand for the development of other power sites, which will bring its total output up to 200,000 h.p. The development of the North Arm plant will be carried on in connection with the construction of the dam at the mouth of Lake Coquitlam, 90 feet in height. This will give a storage capacity in Lake Coonitlam of nine million cubic feet. During December, the company completed the enlargement of the hydraulic tunnel connecting Lake Coquitlam and Lake Buntzen, from which latter point the North Arm generating plant is fed at a head of 400 feet. This tunnel was originally 9 by 9 feet, but has now been increased to 190 square feet in section.

The new equipment at the North Arm station for which coutracts have just been awarded consists of three units, each of 14,000 h.p. The John McDougall, Caledonian Iron Works, Montreal, will supply the 14,000 h.p. waterwheels which will be of the Doble type. They will be the largest of their kind in Amcrica. The electrical equipment will consist of three generators, each of 9,000 k.v.a. capacity, and capahle of overload to the maximum of the hydraulic equipment. The three new units will be housed in an independent generating station, located on the waterfront of the North Arm at a point about 2,000 feet south of the existing generating station. To convey the water from Lake Buntzen to the station, a hydraulic tunnel will be driven through solid granite. This tunnel will be 2,250 feet long, with an internal diameter of 15 ft. 6 inches, and concrete lined throughout, to bring the friction factor to the lowest possible point.

TRADE NOTES.

Mussens, Limited, dealers in railway, contractors, mining and municipal machinery and supplies, have sent us an office calendar for 1912. A number of the principal lines handled by the company are displayed on the various sheets of the calendar.

Heenan & Froude, Manchester, England, have been awarded a silver medal by the Royal Sanitary Institute for their "Trough Grate for Refuse Destructors." Before deciding the award, two experienced judges went to Hertford to see the grate and clinkering apparatus in operation. Laurie & Lamb, Board of Trade Building, Montreal, are the Canadian representatives.

The Robb Engineering Co., Amherst, N.S., report that the Government General Hospital, St. John's, Newfoundland, is to install three Robb Brady Scotch boilers. One of these is for 50 h.p. rating, and the other two for 75 h.p. This type boiler, which has been upon the market but a short time, is an improved form of the standard marine Scotch boiler, two drums being used in place of the single drum in order to get rapid circulation and eliminate expensive staying of the combustion chamber. Other orders recently received, comprise the installation at the Pacific Pass Collieries, Bickerdike, Alta., of two Robb Brady 40 in. x 16 ft. boilers, built for 125 pounds working pressure. These boilers are to be used in developing the new collieries, and are built according to the requirements of the Alberta by-laws and inspection. Each boiler is to have a 22½ in. x 60 ft. stack. A. F. Bentley & Sons, St. Martins, N.B., are to install a 54 in. x 16 ft. boiler of the same type, with a 26 in. x 35 ft. stack. The Dominion Coal Company are equipping their coal handling plant at Wind Mill Point with more modern machinery, and have purchased from the Rohb Engineering Co., Ltd., ten vertical boilers 60 in. x 13 ft. 6 in., with vertical submerged tubes. These boilers are built according to the requirements of the Montreal city by-laws and inspection, for 140 pounds working pressure.

H. W. Ward & Co., Machine Tool Builders, Birmingham, England, inform us that they have made arrangements with the purchaser of the freehold of the Lorraine-Dietrich Works, Bournbrook, for their occupation, to relieve the congested state of their present works, and afford greater facilities for the manufacture of their products. They are installing new machinery, and intend commencing operations immediately at the beginning of the New Year.

CATALOGUES.

Laurie & Lamb, Engineers, Montreal and Vancouver, have issued a pamphlet, illustrative and descriptive of the various specialties handled by them, which shows at a glance the widespread effective and successful application of such mechanisms as the Belliss & Morcom high speed engines and air compressors, the Heenan & Froude refuse destructors, the Patersou water filtration system, etc.

Verity's Ltd. Aston, Birmingham, England, have sent us illustrated price lists of their English-made Tungsten lamps, and also of their Aston Farm House lighting sets. These cousist of a gasoline engine and a dynamo direct-coupled and mounted on one base. An accumulator and switchboard complete an outfit, which is to be recommended on account of its easy portability. These sets are supplied in six sizes, suitable for from 28 to 225 lamps of 20 watts. Prices are quoted in Canadian currency, aud are very reasonable.

The Lunkenheimer Co., Cincinnati, Ohio, has recently issued au attractive booklet describing their various types of blow-off valves, and they will be pleased to send it upon request.

The Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa., have sent us their circulars No. 1028 and 1190. The first illustrates and describes numerous examples of rotary converters, while the second deals with type E engine-driven A. C. generators.

The Allis-Chalmers Co., Milwaukee, Wis., have forwarded a copy of their Bulletin No. 1083, setting forth the distinctive features of their D. C. generators and showing numerous examples of their application to the direct driving of machine tools.

The Canadian Gasket Co., Bridgeburg, Ont., send us their price list of gaskets. Among other types listed are plain and corrugated copper gaskets, those with asbestos cord-filled corrugated, smooth copper gaskets with asbestos filling, lead gaskets for ammonia fittings, oval gaskets for man-holes, hand-holes, etc.

Poetter, G. M. B. H., Ltd., Dusseldorf, Germany, have sent us a copy of their latest catalogue of gas producers, constructed on the Hilger system. These producers have a slowly rotating ash pan and a star shaped grate. Through the rotation of both of these the ash in the producer is kept constantly in motion, thus preventing formation of clinker. Moreover, by these means new surfaces of the fuel are being constantly brought under the influence of the blast, with the result that gasification is greatly hastened. A gas producer of 10 feet internal diameter is claimed to be capable of dealing with 25 long tons of coal or 36 tons of lignite per 24 hours.

Chambers & Simpson, Engineers, Toronto and Brantford, have gifted us the handsome leather-bound pocket diary issued by their principals, the Campbell Gas Engine Co., Halifax, England. Besides containing a large amount of highly instructive and valuable data dealing with the various products of that firm, there is a most interesting detailed calendar of prominent occurrences and feast days, and in addition to a neatly arranged memorandum department, an accident insurance coupon contributes to its further possible utility.

Darling Bros., Ltd., Montreal, have issued the 1912 edition of their handy little condensed catalogue of steam specialties, feed water heaters, vacuum valves, feed pumps, etc. A double frontispiece shows portraits of the firm's engineers and representatives in Montreal, Toronto, St. John, N.B., Winnipeg and Vancouver. The little book measures 6 x 3½ inches, and is well printed on faced paper.

The Devoe Electric Switch Co.

Switches
Switch Boards
Switch Boxes
Panel Boards

WRITE
157 Craig West, - MONTREAL

DO NOT THINK

Your boilers are FREE FROM SCALE, but make a THOROUGH EXAMINATION and find out for sure. If your FUEL BILLS are EXCESSIVE, or your steaming capacity if BELOW NORMAL, there is a CAUSE and the chances are you will find SCALE is RESPONSIBLE. A LIBERTY CLEANER is the best DETECTIVE to put on the job. If there is any SCALE it will not only FIND, but effectually REMOVE it. Let us send you one to make an investigation. If you find you have no need for it, we don't want you to keep it. WRITE TO-DAY FOR CATALOGUE.

LIBERTY MANUFACTURING CO.

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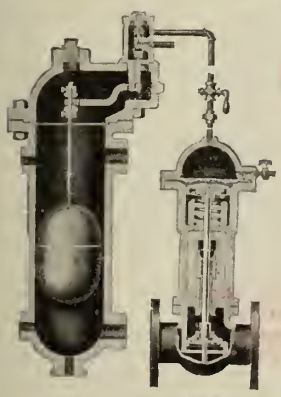
DO YOU KNOW

What to Replace or Add to Your Power Plant to Put it in First Class Shape?

We have a line of Power Accessories which have been designed and constructed as a result of practical experience which fully meet the requirements no matter how severe the conditions may be.

Here are a few that will act as helpers in reaching a decision

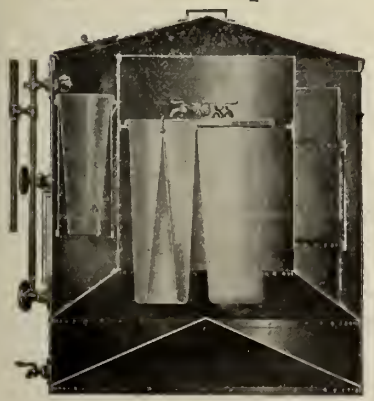
The water entering your suction line contains **solid matters** which are **detrimental** to the equipment. **A Strainer** will **eliminate** these. The **Twin** is the best, because it is the simplest and can be **cleaned** without interrupting the flow of water. Just think what that means—***continuous operation.***



You Often Get Tired

looking at the water glass and regulating the pumps by hand to suit the demands made by the boilers. Why don't you have a Feed Water Regulator and Pump Governor do this for you?

Have you tried Regulators and found the valves stuck? Well, **ours can't stick.** The **inlet** and **outlet valves** are both **positive** in their operation. They will do the work better than you can, reduce the operating cost and give you an opportunity to look after the many other things that need attention.



What Becomes of Your Dirty Oil?

Is it thrown away or do you run it through a filter? Does this filter contain waste, charcoal or some other substance which removes only the grit? It would pay you to investigate **our method** which is entirely different from the others. Will it work? Sure—and not only filters but **purifies** the oil as well.

We make single or system purifiers of any capacity. If you think your condition is different from the others, tell us about it—we are always looking for something new.

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DUNLOP

PISTON ROD PACKING

works equally as well on a heavy pump as on the most sensitive valve stems. No matter for what purpose used—steam, water, ammonia—it proves to be highly effective. Oils, alkalies, etc., do not affect the life of the packing in any way.

The pressure of Dunlop Piston Rod Packing on the rod is never greater than necessary, therefore friction is reduced to the minimum. It is self-lubricating and cannot become hard under any condition. This is a big point in its favor when you consider that hardened packing will not give, thus causing great pressure on the rod; with the result: greatly increased friction and loss of power. The lubricants used in the preparation of Dunlop Piston Rod Packing are the best and most approved of. They enamel the rod (filling in the scores, if any) and assist it to work easily and freely. The packing is self-adjustable and is not affected by the vibration of the rod.

Dunlop Piston Rod Packing before pressure from the Gland is applied in the Stuffing Box.

When in the market for Packing, Belting, Hose, Valves, etc., consult us. We have everything that will meet your requirements and give the greatest satisfaction. We make a suitable article for every specific purpose. If you purchase our line you will be one of the many who realize that fact.

Link yourself up with our "Two Hands" trademark---it's your protection and satisfaction.

Dunlop Piston Rod Packing under pressure, showing how it expands to take up wear from the rod.

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A sure cure for any groan or squeak is

DIXON'S FLAKE GRAPHITE

"The world's most perfect lubricant."

Remember that Dixon's Flake Graphite is furnished in finely powdered form when desired—but with all the virtues of the flake, and will not ball up or cake

"Graphite as a Lubricant" and Sample 222-c Free.

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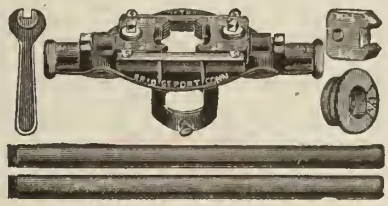
SOLD ALL OVER THE WORLD



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PIPE CUTTERS
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RATCHET ATTACHMENTS

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Catalog mailed on request

THE
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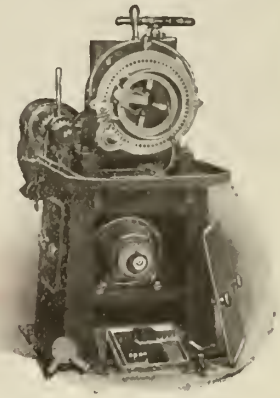
PIPE CUTTING AND THREADING MACHINE



has all the advantages of the belt driven type, with compactness, power-saving and unusual operating convenience in addition. The motor is concealed inside the base of machine, the various speed changes are under lever control: no friction losses, no wasted power.

The absence of countershafts permits heavy lengths of pipe to be handled with cranes or overhead trolleys, or the machine can be taken to the work.

Full description on request. Write us.

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Power Transmission Equipment and Machinery

MECHANICAL MATERIAL CONVEYORS, INDUSTRIAL RAILWAYS.
Including Rails, Switches, Frogs, Cars, etc.,
—FOR—
MILLS, FACTORIES, MINES, GRAIN ELEVATORS

We carry in Stock a complete line of Transmission Equipment as below.

Iron Pulleys,
Solid and Split
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Bearings,
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Couplings,
Post Hangers,
Post Boxes,
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Boots,
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Equipment and Supplies for 50 Grain Elevators carried in stock at all times.
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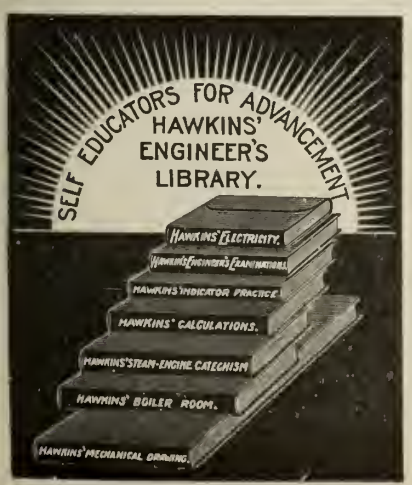

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Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

YOU can reduce the labor and expense of boiler cleaning and cut down your consumption of fuel by using

McCOLL'S Special Boiler Compounds

or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

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Dearborn Feed Water Treatment

Dearborn Treatment is scientifically prepared to meet individual water conditions, and will remove and prevent scale formation without the slightest injury to the tubes. All corrosion, pitting and other injurious action of the water is overcome; the boilers are constantly clean, and there is no waste of time and money for repairs, cleaning boilers mechanically, etc.

All we ask is that you give Dearborn Treatment a fair trial and we will guarantee results.

Send us a gallon of your feed water for analysis, and we will advise you regarding cost of special treatment for your plant.

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BOILER ENAMEL

is a guaranteed preventative of boiler scale, pitting, corrosion, priming, foaming, etc., which will work equally well in any class of feed water.

"ECLIPSE" is made entirely from tropical plants, and in the process of manufacture no chemicals of any kind are added. It is chemicals that prove disastrous to many boilers and their fittings.

Being harmless, it is slow in its action on old scale, but is deadly sure.

The cost of using "ECLIPSE" in your boilers cannot be compared with the great saving that results from its use.

PROFIT BY THE EXPERIENCE OF OTHERS by writing us for testimonials from many well-known firms in Canada who use this boiler enamel. Their verdict will convince you that "ECLIPSE" will save money.

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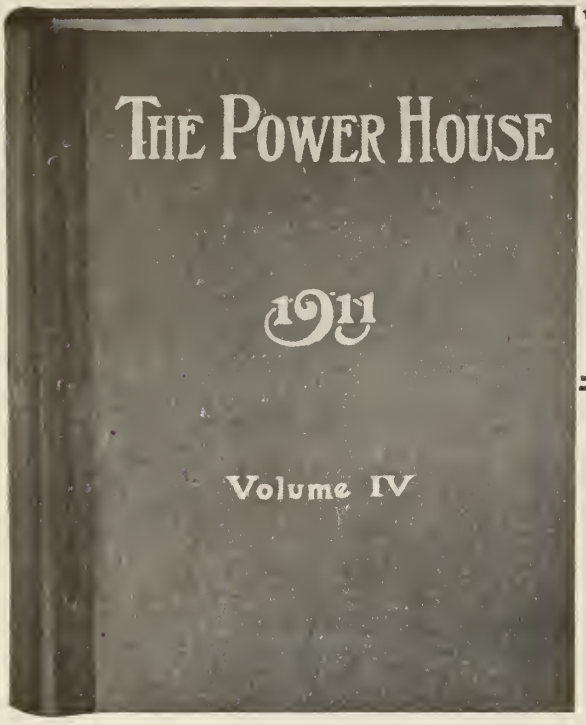

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make **97** per cent. purification of water a practical possibility. The percentage of filtration is often higher.

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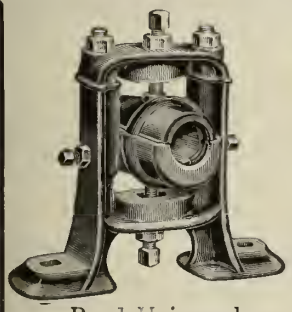

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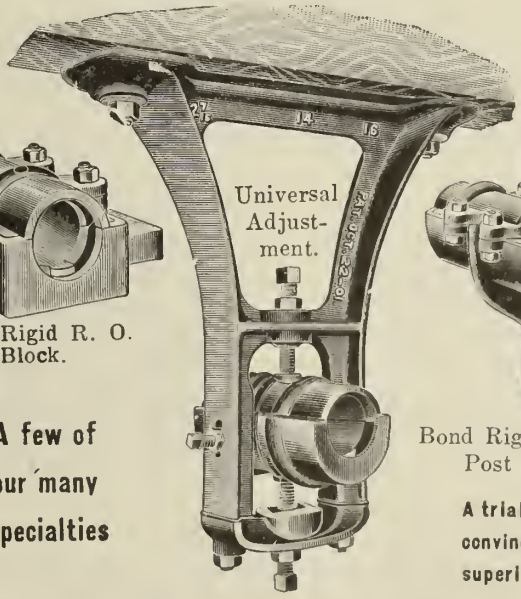

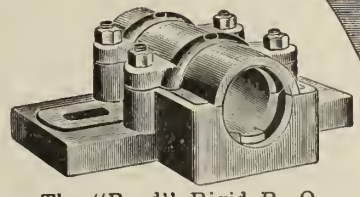

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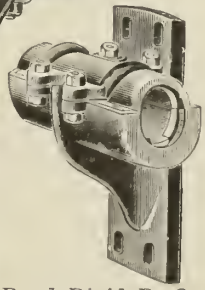
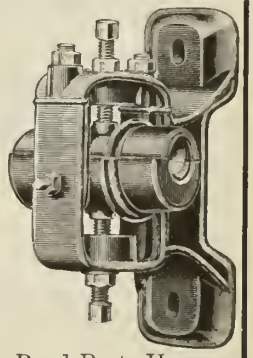


Bond Rigid R. O. Post Box



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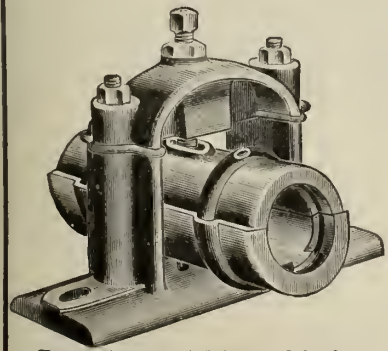
A trial order will convince you of its superior merits.



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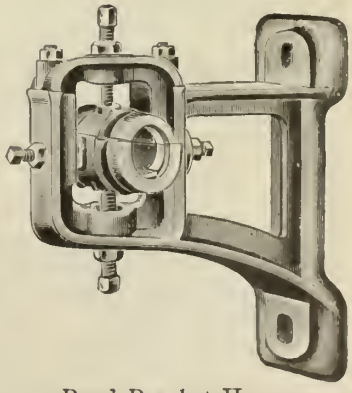

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BELTING

Scandinavia Belting is made of the best grade of Cotton and woven solid in one piece. It is woven in such a manner that about ninety per cent. of the material is used to give the belt strength in the direction in which it is required.

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IS best for all drives in damp or wet places. Moisture has no more effect on "AMPHIBIA" than on the Frog from which the brand name is derived.

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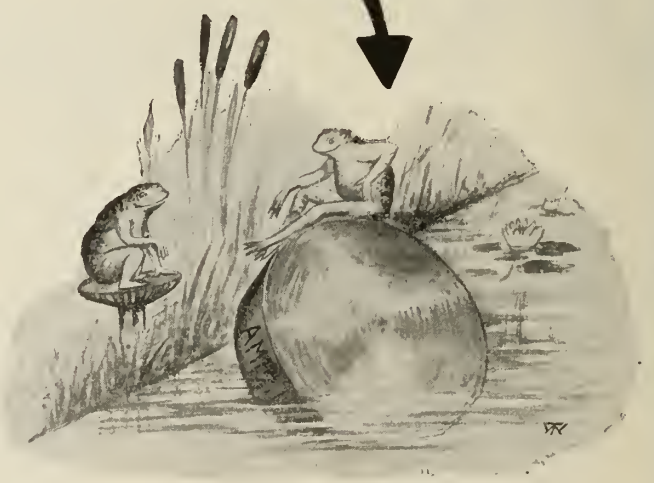

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This **DOES** make a difference to you.

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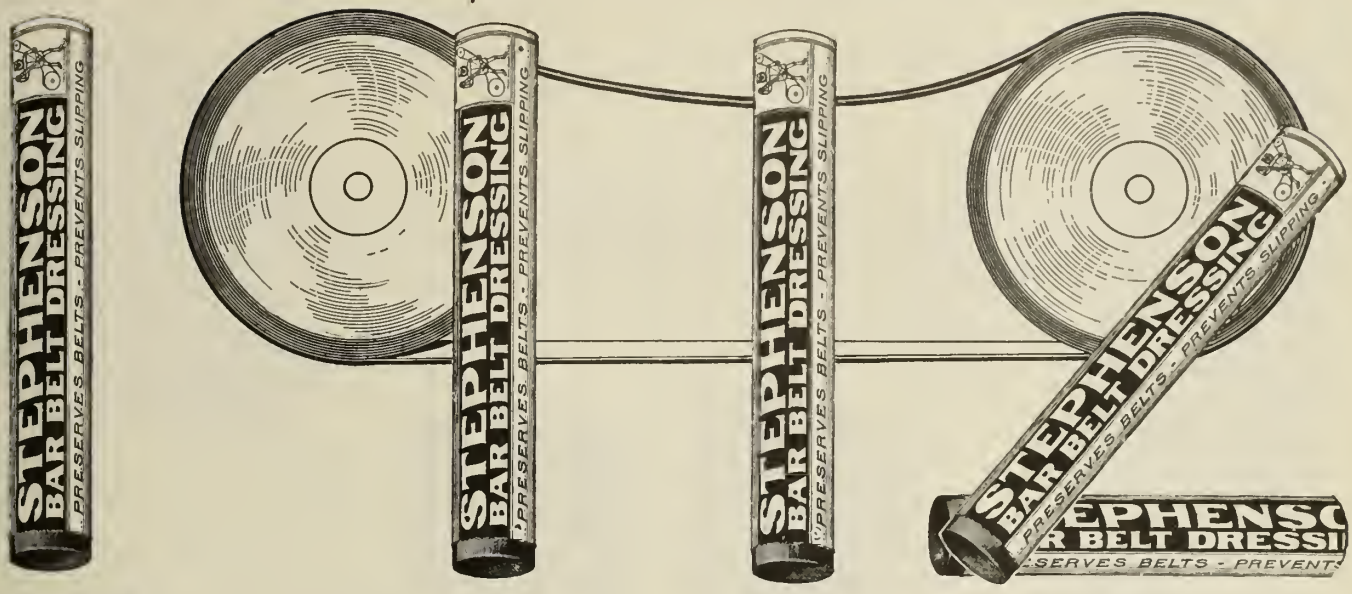

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Make 1912 a record-breaking year. Turn over a new leaf and get rid of the things that have been causing needless trouble and expense. Adopt the things which will make your work easier, give better results and save money for your employer. You cannot start at a better place than with your belt dressing.

Get rid of those troublesome liquid dressings. Shake the can for the Stephenson solid stick and shake trouble at the same time.

Stephenson Bar Belt Dressing is a friend in need. It doesn't require preparation, nor do you have to use especial care in applying it. The minute the belt slips you hold the Stephenson bar to the belt for a few seconds and ths slipping stops. There's no waste—no slop—no smearing on of paste or pouring on of spattering liquid. And the results are better. Make this your first New Year's resolution—

I'll **"Stick to the Solid Stick."**

Start 1912 With A Free ½ Lb. Sample

Simply send us your name and address and we'll send you a New Year's present in the shape of a free half-pound sample of Stephenson Bar Belt Dressing.

Remember—we give you this sample absolutely free of charge. Get this free half-pound of the finest belt dressing made and test it. Here's your chance to try something really good at no expense.

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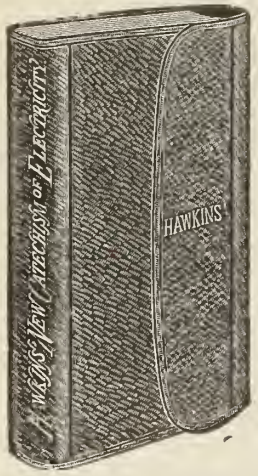
Books for the Engineer's Library



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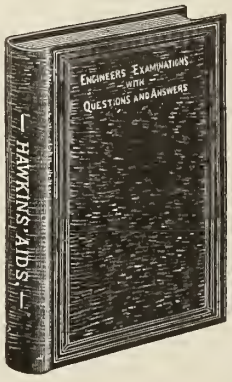

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By N. Hawkins, M.E.

It presents in a condensed form the most approved practice in the care and management of steam boilers, engines, pumps, electrical and refrigerating machines, with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the steam engine and steam boiler.—$2.00.

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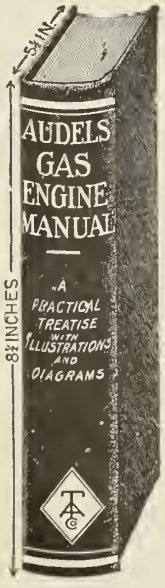

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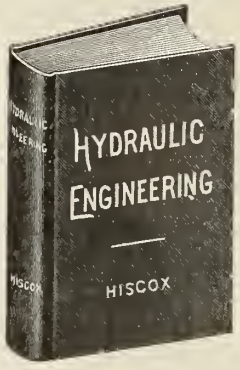

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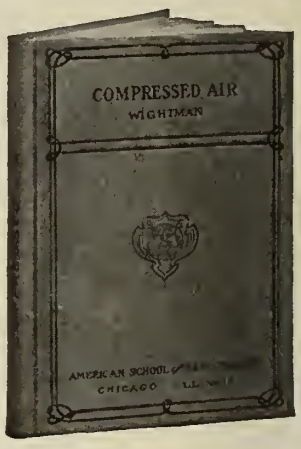

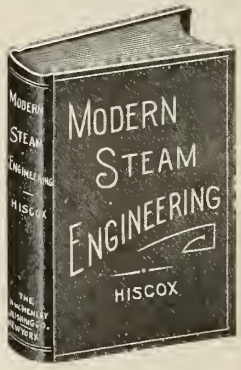

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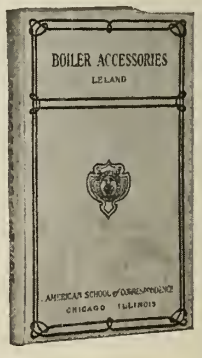

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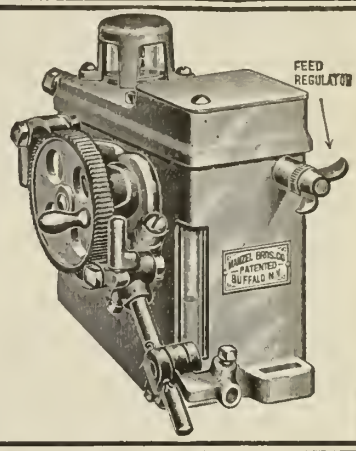

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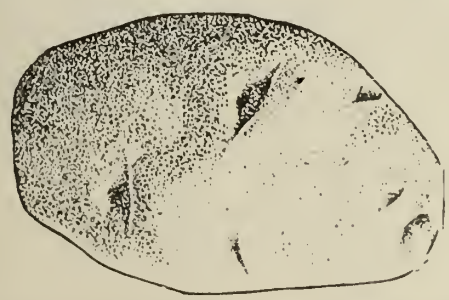

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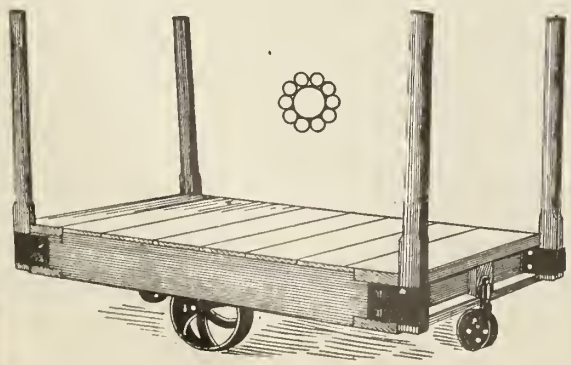

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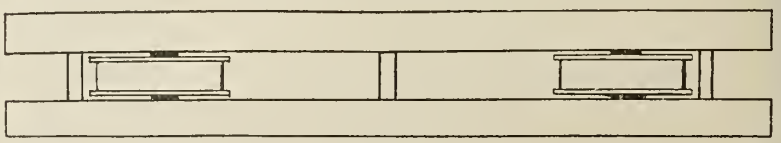

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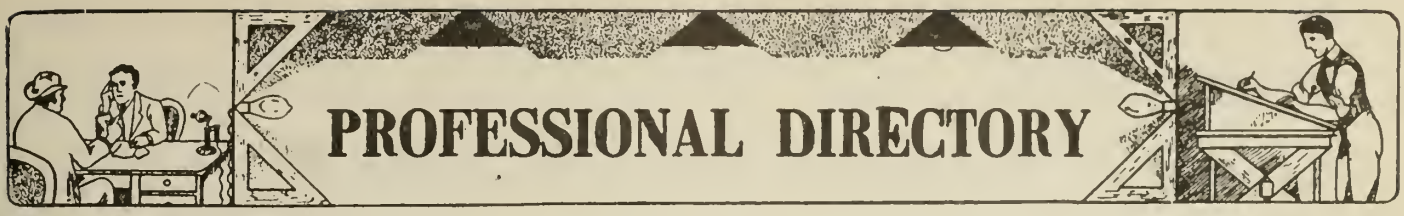

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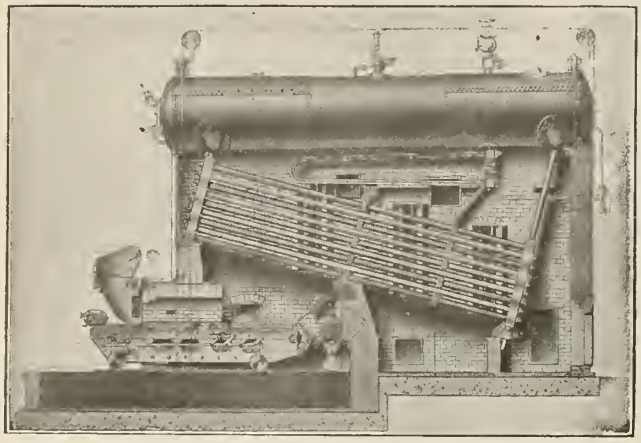

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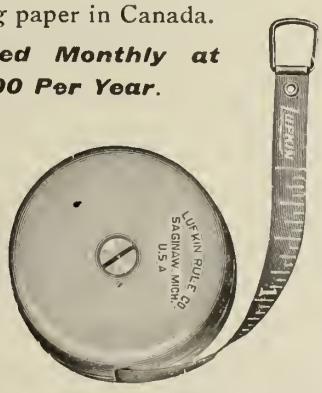

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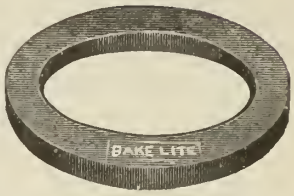

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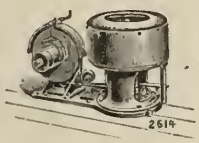
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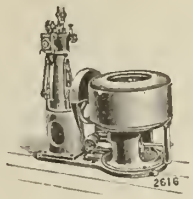
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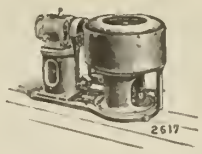
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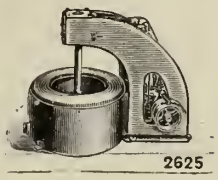
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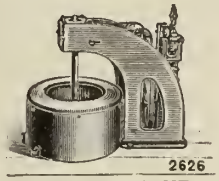
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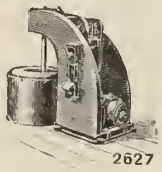
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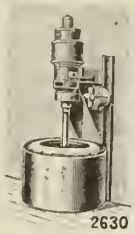
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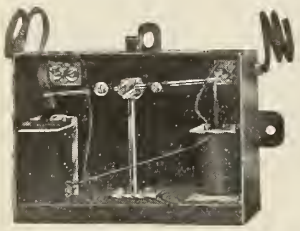

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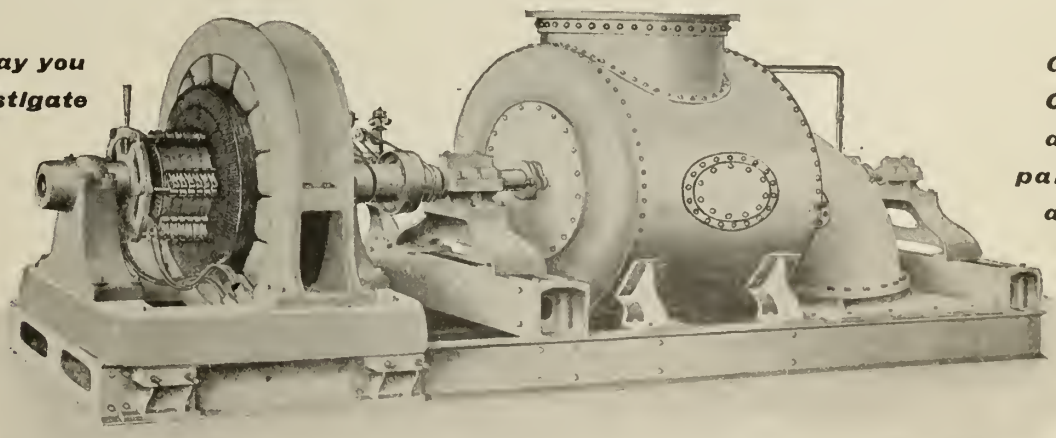

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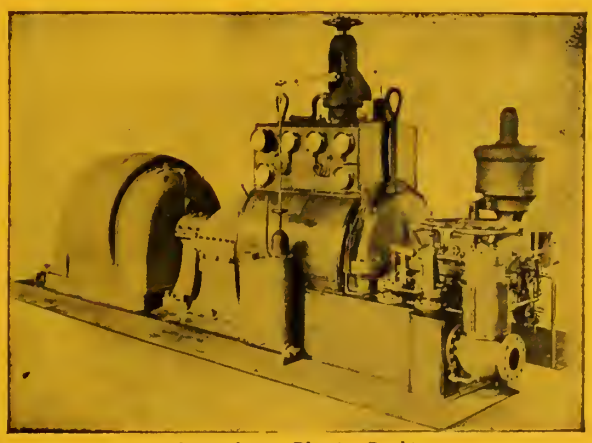

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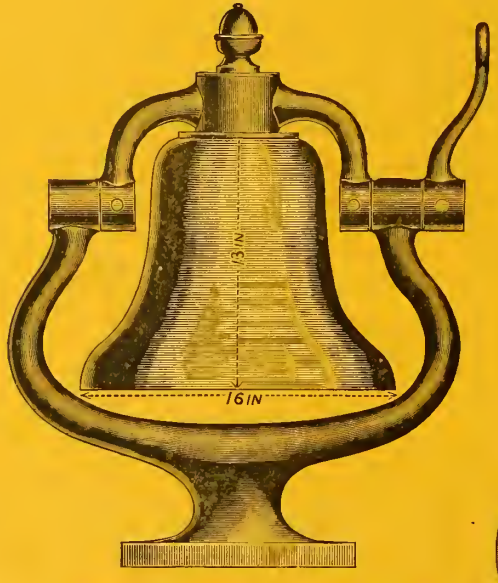

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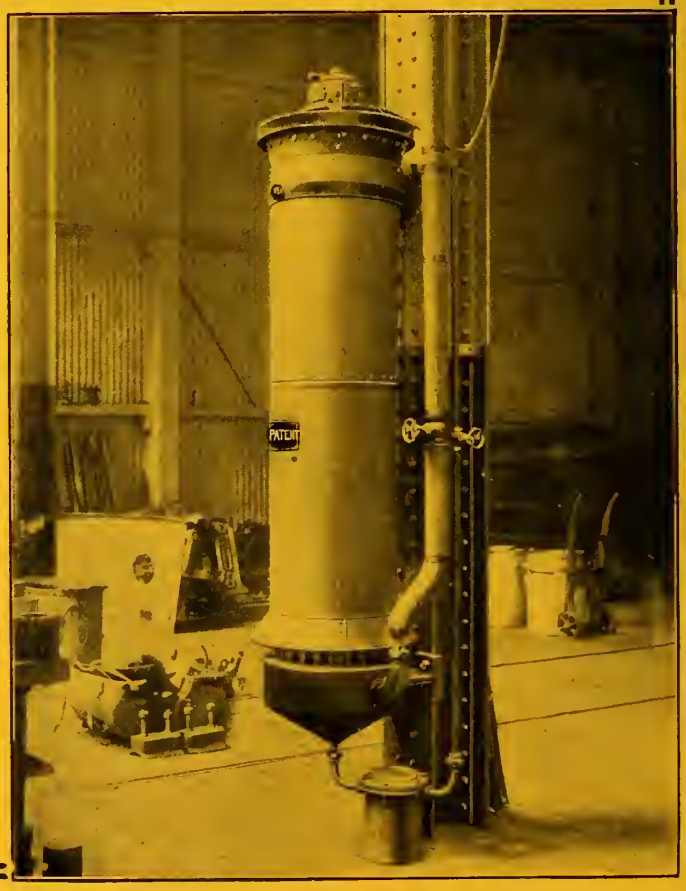

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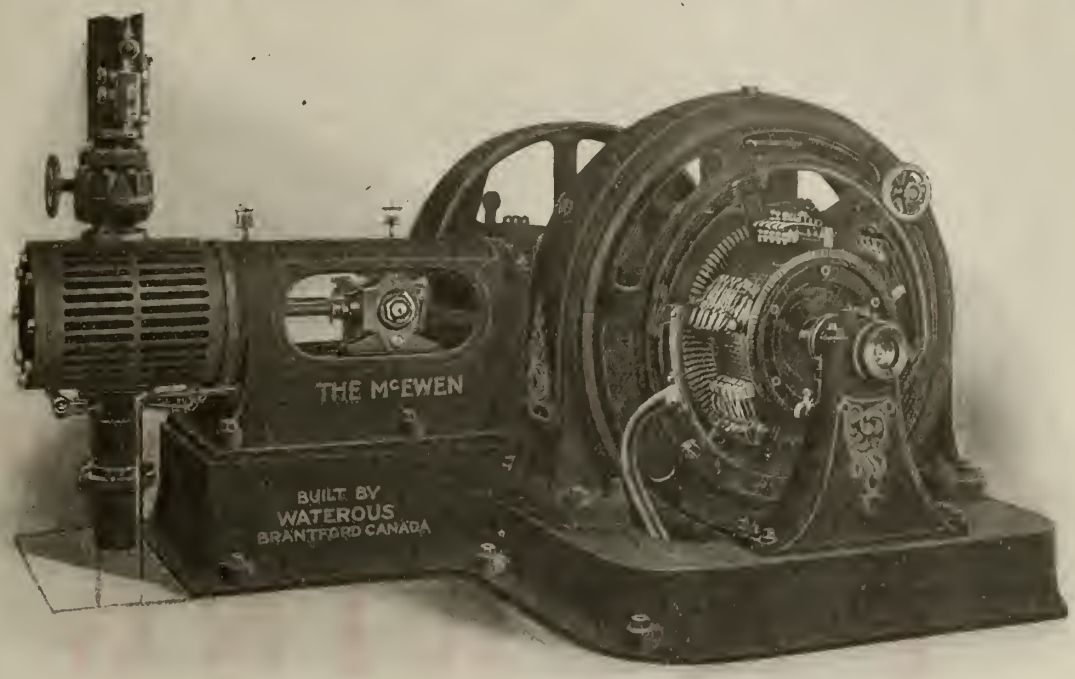


McEwen High Speed Automatic Engines

Continuous Power for the Isolated Plant

Directly connected to generator, the McEwen Automatic Engine makes an ideal installation for the continuous production of electric light and power.

The difference in initial cost as compared with a throttling type engine is quickly compensated for in greater ease of operation, greater durability, in closeness of regulation, economy in steam consumption and in the wide range of power at command.

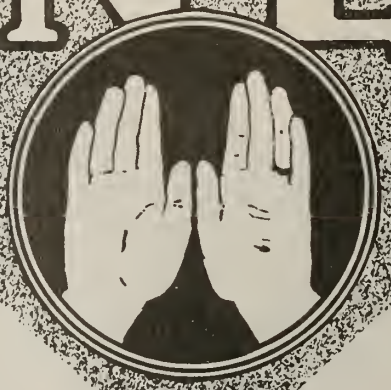
The simplest and strongest high-grade engine on the market, the McEwen is fitted with an automatic flywheel governor—the Begthrup—which has never been surpassed for closeness and speed of regulation. It can be regulated to govern within the limit of one revolution without difficulty. We guarantee this.

The McEwen Engine is built in simple and compound units up to 700 H.P. It is adapted to all kinds of work, but its particular field is driving electric generators for lighting, power, street railway and mine haulage.

Our McEwen Booklet is full of interest to the Operating Engineer or Power Plant Owner. A post card will do.

The Waterous Engine Works Company, Limited
Brantford, Canada

DUNLOP



HIGH GRADE PISTON ROD

PACKING

is self lubricating and cannot become hard under any condition.

The pressure of **DUNLOP** Piston Rod Packing on the rod is never greater than necessary, therefore friction is reduced to a minimum, adding longer life to machinery, with less power consumption.

This packing is self adjustable, and is not affected by the vibration of the rod.

It proves highly effective when used in connection with steam, water, ammonia, oils, alkalis, etc., which cannot impair its efficiency.

When you require Packing, Belting, Hose, Valves, etc., write us. We can meet your wants in the best possible way, and give you prices that are right.

DUNLOP TIRE & RUBBER GOODS
COMPANY, LIMITED
Head Office and Works: TORONTO

Give our goods a trial.

Our "Two Hands" trade mark is your proteection.

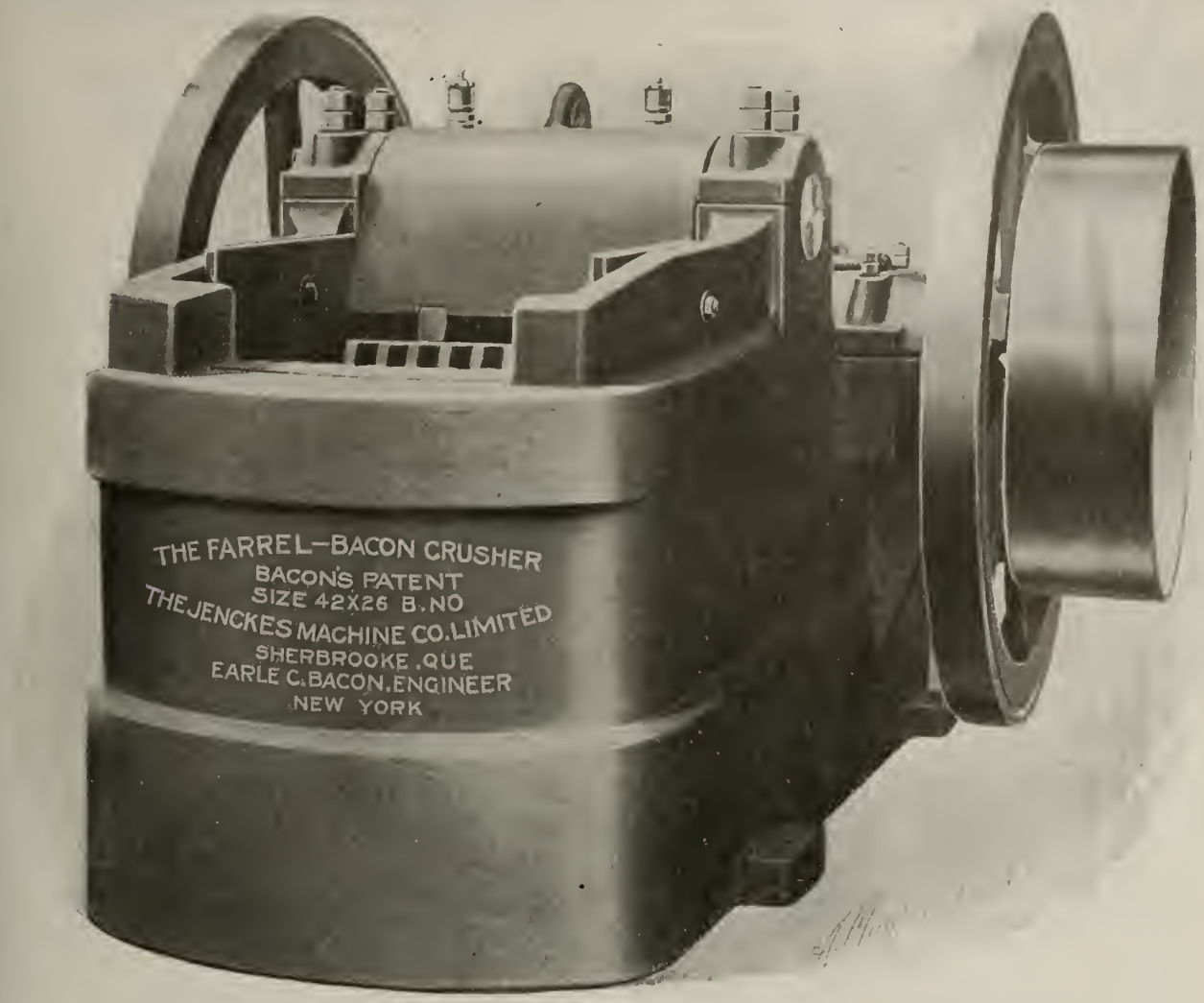
Dunlop Piston Rod Packing before pressure from the Gland is applied in the Stuffing Box.

Dunlop Piston Rod Packing under pressure, showing how it expands to take up wear from the rod.

BRANCHES:

Toronto, Montreal, Winnipeg, Vancouver, St. John, N.B.; Calgary, Victoria, London, Ont., Regina, Ottawa, Cobalt, Nelson, Hamilton.

The Jenckes Machine Company, Limited



THE FARREL-BACON "B" Pattern Improved

Ore and Rock Crusher

Patented

Sizes 42x26 and 42x30 inches **Numbers 26-B and 27-B**

DIMENSIONS, CAPACITY, PRICE, ETC.

No.	Size of Rec'g Capacity	Approximate Capacity in Tons per day of 10 hours, to any one of the sizes stated	Size of Pulley	Revs. of Pulley	H.P. Required	Total Weight	Weight of Heaviest Piece	Price with Chilled Iron Jaw Plates	Price with Steel Jaw Plates
	Inches	Tons Ins. | Tons Ins. | Tons Ins. | Tons Ins.	Inches			Lbs.	Lbs.		
26-B	42 x 26	750 to 3½ | 700 to 3 | 650 to 2½	54 x 20	300	100	119000	63700	$	$
27-B	42 x 30	1500 Tons from 6 to 8 inches	54 x 20	300	100	123000	66000	$	$

Sizes Nos. 26 and 27-B are especially designed and constructed for breaking down large size material to sizes stated, saving expense of sledging; and for the hardest kind of rock or ore.

In ordering, or in writing for information, as to size, etc., best adapted, state kind of rock or ore to be broken, for what purpose, and the size of product required.

The capacities stated in list are approximate, and based on a rock or ore that is hard and friable, and vary according to the nature of the material to be broken; and the horse power varies somewhat also, according to the character of material to be broken, that given in table is a fair average; but it is always well to arrange for surplus power.

ALL SIZES GENERALLY IN STOCK OR IN PROCESS OF CONSTRUCTION

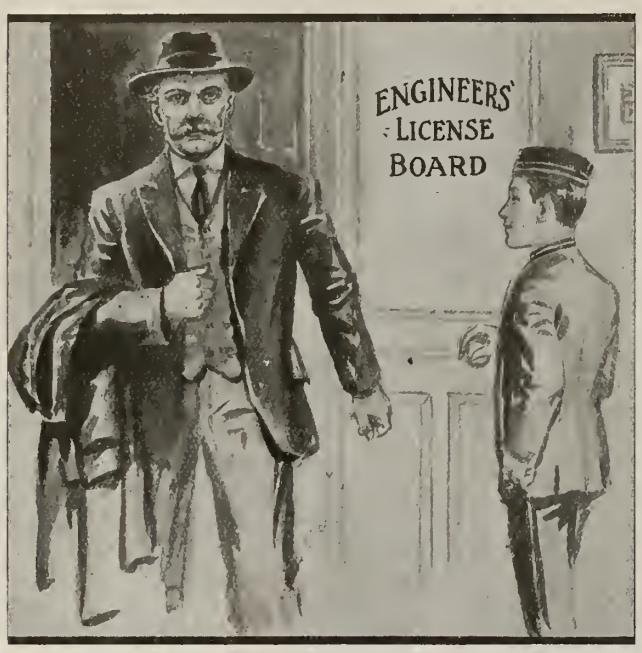
Plants: Sherbrooke, Que., St. Catharines, Ont.

THIS IS A SPECIMEN PAGE FROM OUR NEW "CRUSHING MACHINERY" CATALOG. COPY ON REQUEST

The Jenckes Machine Co., Ltd. - SHERBROOKE, QUE. ST. CATHARINES, ONT.

The advertiser would like to know where you saw his advertisement—tell him.

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY



Are You Prepared to Face the License Board?

Simply the everyday experience of an engineer does not qualify him to pass the rigid examination of the License Board. But in order that YOU might have a line on the questions asked, and the answers expected, we've had prepared a Blue Book of Questions and Answers to Engineers' License and Civil Service Examinations.

If you want a FREE copy of this valuable little book, comply with the easy requirements mentioned below:

How to get the Hand-book FREE

Fill out the Coupon and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and look at Daniels' P.P.P. Packing.

YOUR NAME .....
ADDRESS .....
EMPLOYED BY .....
ADDRESS .....
HORSEPOWER OF ENGINE .....
KIND OF ROD PACKING USED .....
DO YOU USE EBONITE SHEET PACKING? .....
DEALER'S NAME .....
ADDRESS .....
..... Series 24-B

If your dealer doesn't carry P.P.P., we will write telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

Stop Wasting Coal

No man, not even the man with the least knowledge of running a steam engine, would run it under a **brake.** Yet, in effect, this is exactly what every engineer, **using a SOLID Rod Packing,** is doing. Take the "brake" off YOUR engine – use

Daniels'
P. P. P.
Rod Packing

The famous "give-and-take" construction of P.P.P. permits the packing to adjust itself instantly to a pressure of 200 pounds or 5 pounds.

P.P.P. is the only Rod Packing backed by scientific tests. Noted mechanical engineers have demonstrated that P.P.P. is indeed the perfect Rod Packing. Let us send you these reports.

"Regular"

Three Styles: "Regular," "Special," and "Marine." All styles are furnished in Coil, Spiral, and Ring forms.

FREE To Users of P.P.P.

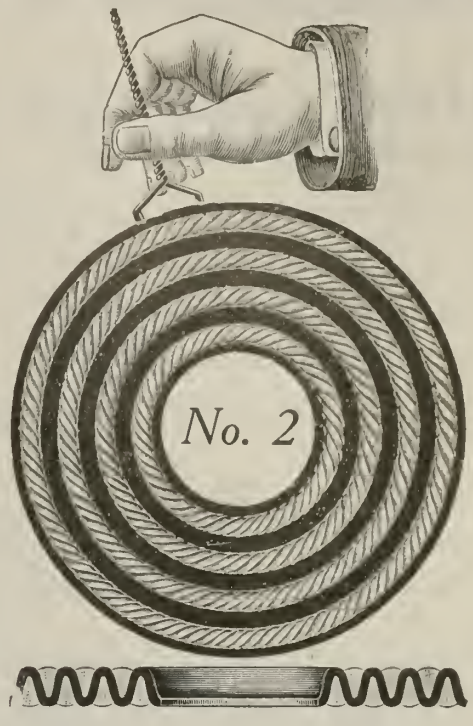
If you are a user of P.P.P., fill out the coupon and mail it us. We will send the Engineers' Examination Book to your dealer (or one we name) who will hand it to you when you call at his store and look at Daniels' EBONITE Sheet Packing.

QUAKER CITY RUBBER COMPANY
Manufacturers of Mechanical Rubber Goods
PHILADELPHIA, PA., U.S.A.

Your Orders and Specification must call for Genuine

GOETZE

NUMBER TWO GASKETS



Only the best things are imitated. For your own good, do not be deceived by imitations of this obviously superior Gasket, no matter what claims may be made for them. "Just as good" is an unwitting acknowledgment that Goetze's Gaskets are the standard by which other Gaskets are measured. When you want this Gasket order Genuine Goetze Elastic Corrugated Copper Gasket with Asbestos Lining No. 2. There is nothing "just as good."

Our five years' Guaranty stands for Service, Durability, Economy.

Can you get anything better?

Or as good?

Genuine Goetze's No. 2 Gaskets on 90 days' trial, to be paid for only if they make good in your plant! TRY THEM.

S'pose You Have YOUR Troubles With Valve Gaskets, Too

If you don't, we congratulate you and wish you *more* luck. For it's just a matter of luck, if you're using the usual rubber or combination discs.

If, on the other hand, you're with the great majority who are in "hot water" or hot steam a good part of the time on account of poor valve gaskets, we ask for a chance to show you, on your own valves, that you don't have to put up with such annoyance and expense a minute longer than you want to.

Send, Now, For a Supply of Goetze's Copper Valve Gaskets with Asbestos Core on 90 Days' Trial at Our Risk.

They're for valves of Jenkins or similar types. Simply say how many and what sizes you want and whether you want the round hole or with two flat sides.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

St. John, N.B.

BRANCHES AT

MONTREAL
163 Esplanade Ave.

WINNIPEG
C. E. Chown, 147 Bannatyne Ave.

VANCOUVER
A. O. Campbell, 1069 Hamilton St.

MANUFACTURED BY

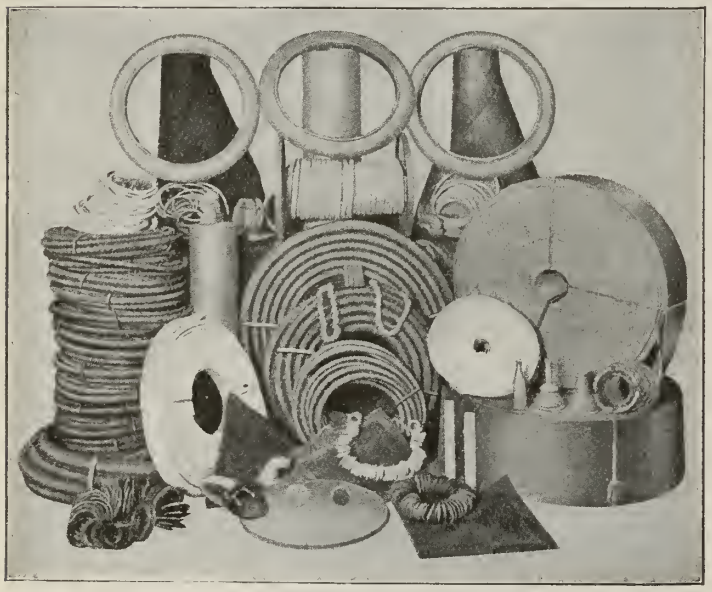
Goetze Gasket & Packing Co.

NEW BRUNSWICK, N.J.

Heat and Oil-Resisting Steam Hose

You don't buy hose every day. When you ***do*** buy, it's up to you to remember that the ***best*** you can buy ***to-day*** is the ***cheapest*** you can use to-morrow—and demand

GOODYEAR
Steam and Hot Water Hose
Dependable Hose for Boiler Rooms



A Few of the Lines We Carry.

This hose is ***specially treated*** to yield the maximum resistance to steam and ***oil***—agencies that play havoc with other hose, ***shortening its usefulness*** and ***doubling its cost.*** The toughest, strongest, least-affected-by-heat hose in existence—and the most economical.

In addition to Goodyear Steam and Hot Water Hose, we also make highest grade

Fire Hose
Air Hose
Suction Hose

as well as special hose for

Oil, Gasoline, Vinegar, Fire Extinguishers Brewers and Divers

If ***ultimate saving*** is worth your while, buy ***Goodyear*** Hose. In every foot you get the same high quality material, skillful workmanship and years of experience that have built such enduring service into the products of the Goodyear Tire & Rubber Company, Akron, Ohio, U.S.A.

Tell us what kind of hose you are interested in.

Let us quote you a ***saving*** price—and ship you ***saving*** goods.

In all of our business in Canada last year, we had to replace, because of slight defects, only $155.22 worth of goods.

The Goodyear Tire & Rubber Company of Canada, Ltd.

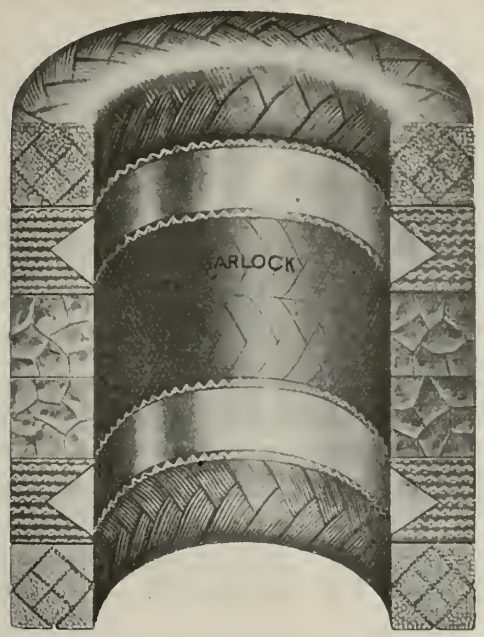
General Offices—Toronto Factory—Bowmanville, Ont.

Write Our Nearest Branch

BRANCHES: Montreal—Winnipeg—St. John, N.B.—Vancouver—Calgary
Victoria, B.C., 855 Fort Street; Regina, Saskatchewan, 2317-2318 South Railway Street; Hamilton, Ont., 127 King Street West

17

It has been demonstrated repeatedly that Garlock Duo Hydraulic—Style No. 960 (Illustrated Below) will hold a pressure of 3000 pounds.



This packing is a combination of braided copper, metal wedge and waterproof hydraulic rings, being expressly designed and built for use in steel mills, blast furnaces, and railroad shops where the demands on packing are most severe. We make other combination sets, suitable for different requirements in hydraulic work.

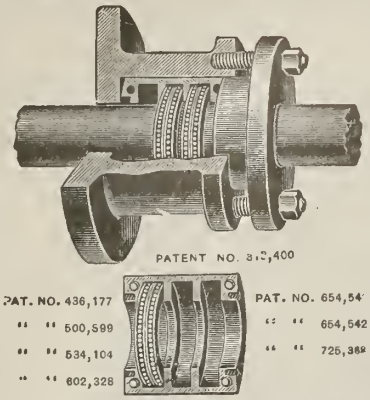
A postal card will bring our new 1912 catalog of 112 pages, showing "Packings for every purpose."

THE GARLOCK PACKING CO.

Head Office and Works, - - - - - HAMILTON, ONT.

PIONEERS IN THE PACKING BUSINESS.

The advertiser would like to know where you saw his advertisement—tell him.



Why not Buy the Best, when in market for Packing?

HOLMES'

Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

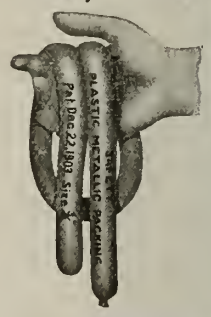
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

Practically Frictionless



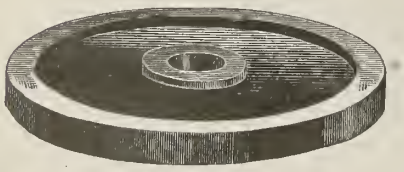
Sold on APPROVAL

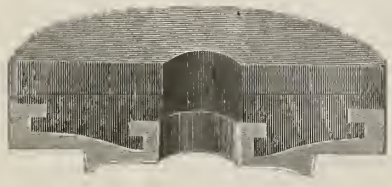
The ASBESTOS & RUBBER GOODS CO.

TORONTO, Ont.
141 King Street East,

MONTREAL, Que.
43 St. Francois Xavier Street,

L. R. & B. PUMP VALVES





Give better service than any other, and last longer

Brass Casing prevents ports from forcing through.

Only best quality of material is used, and as wear takes place the rubber can be replaced until brass casing is reached, thereby giving full use of all the rubber.

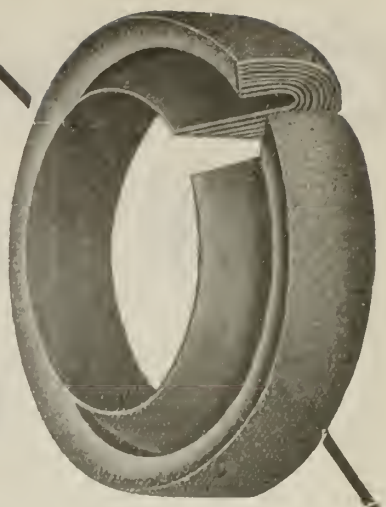
It only needs a trial to convince you.

We also carry a full stock of all other engineers' supplies.

Write us before placing your orders.

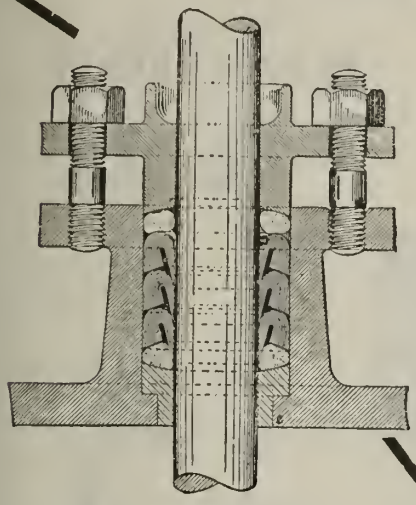
The advertiser would like to know where you saw his advertisement—tell him.

J-M SEA RINGS



The Perfection of Piston Rod and Plunger Packings, Automatic — Economical

Automatic---because the pliable lip or tongue only presses against the rod or plunger when the liquid or gas attempts to pass it, and, moreover, this pressure against the rod is *not constant* but in direct proportion to the tendency of leakage.



Economical---because the friction between the packing and rod is under constant, automatic control and thus reduced to a minimum.

It is self-evident that directly as the friction between packing and rod decreases, the life of the packing is increased.

By eliminating unnecessary friction, power and fuel are saved.

Write our nearest branch for further information about this wedge of laminated Asbestos, Duck or Flax turned over on itself.

THE CANADIAN
H. W. JOHNS - MANVILLE CO., Limited

Manufacturers of Asbestos and Magnesia Products. ASBESTOS Asbestos Roofings, Packings, Electrical Supplies, Etc. 1473

TORONTO, ONT. MONTREAL, QUE. WINNIPEG, MAN. VANCOUVER, B.C.

MADE IN CANADA **R. R. GASKETS** BY CANADIAN LABOR

The Lowest in Cost and Best

High Pressure Gaskets

On the Market.

Manufacturers of all kinds of Metal Gaskets, including the Standard Corrugated Copper Gaskets, Plain or asbestos filled corrugations for Engines, Flange Joints, Pipe Lines, Steam Chest, Cylinder Heads, and all places where a Gasket is required. Will stand any pressure, make the best joints, and are the cheapest Gasket on the market.

Makers of Corrugated Lead Gaskets for Water Pipe Lines, all sizes. Special dies for ice machines or ammonia fittings, boiler gaskets of all descriptions.

Watch for our next ad. and don't forget the R. R. Gaskets.

Write For Prices.

CANADIAN GASKET CO., - BRIDGEBURG, ONT.

FLEXIBLE METAL HOSE

For Conveying Steam, Air, Gas, Etc.

This metal hose is made in either steel or copper and is just as light and flexible as rubber.

It will not kink, burn out or rot, and will give real service under all conditions.

Its lasting qualities are many times greater than those of rubber, and there is practically no cost of maintenance.

Our prices are right. Get our circulars NOW.

The Metallschlauch-Syndikat

PFORZHEIM, BADEN - GERMANY

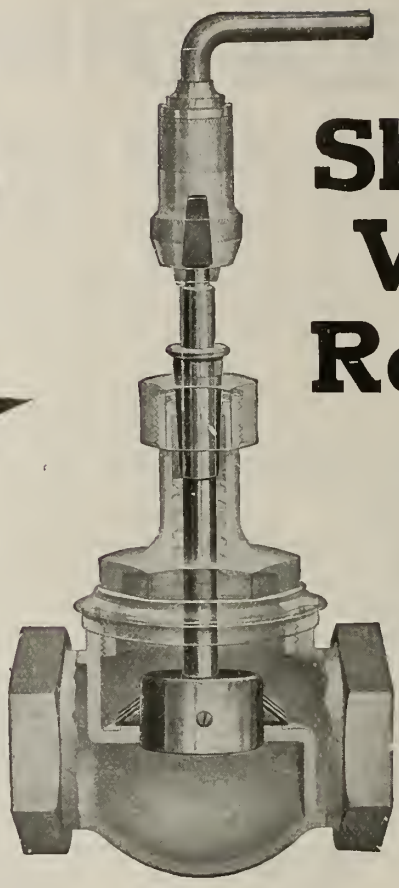
F. J. SCHUCH

19 Jarvis St. - Toronto, Canada

(Canadian Agent)

The advertiser would like to know where you saw his advertisement—tell him.

Get one of these Skinner Valve Re-seating Tools



They will pay for themselves in two or three applications, and

There should be one in every plant

Prices:—

f.o.b. Montreal

1/2 in. to 2 in. - -	$20.00
1/2 in. to 3 in. - - - -	$30.00

Packed in neat wooden box.

H. L. PEILER & COMPANY

MONTREAL	TORONTO	MONCTON, N.B.
380 St. James Street	69 Adelaide Street East	McLeod Building

WESTERN AGENTS:

W. E. SKINNER, Limited

618 Somerset Building
WINNIPEG

TRADE JENKINS MARK
Jenkins Bros.

TRADE JENKINS MARK
Jenkins Bros.

"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for ***genuine*** "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL

FAIRBANKS-MORSE

DUPLEX PUMPS FOR BOILER FEED

AND

GENERAL USE

The Superior Excellence and Splendid Results shown by

FAIRBANKS-MORSE

Pumping Machinery are largely due to the fact that for many years we have manufactured Hydraulic Machinery of all descriptions. We are therefore able to build pumps of all capacities which are properly designed and adapted to every day use. You will get all that is essential and important in pumps when you purchase a "FAIRBANKS-MORSE" Pump.

LET US SOLVE YOUR PUMP PROBLEMS.

The CANADIAN FAIRBANKS-MORSE CO., Limited

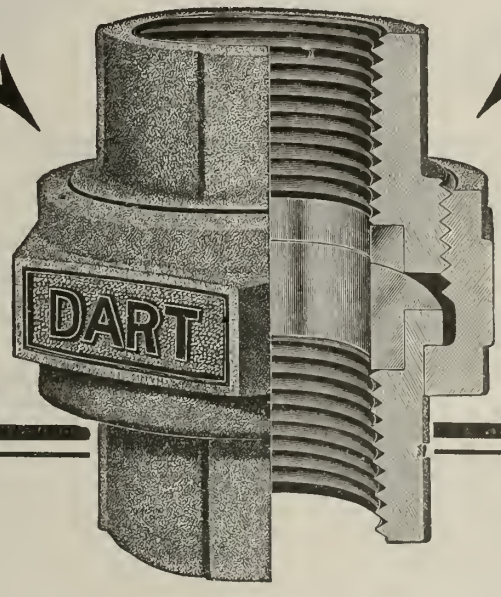
Fairbanks Standard Scales—Fairbanks-Morse Gas Engines—
Safes and Vaults.

MONTREAL	TORONTO	WINNIPEG
ST. JOHN	CALGARY	VANCOUVER
OTTAWA	SASKATOON	VICTORIA

The DART UNION Cannot Leak or Corrode

BRONZE TO BRONZE

AT THE JOINT



Dart unions are not affected by expansion, contraction or vibration, and connect pipes in such a manner that the joints never leak.

That is not all. They can be quickly connected time after time and without bother or expense.

IT is that bronze to bronze ground ball joint of the Dart that makes possible these results; bronze on both faces of the joint, so that neither one can rust or corrode. Then the heavy iron parts insure durability.

Make all pipe connections throughout your plant with Dart unions and you will have satisfaction with the joints.

Any dealer can supply Dart unions, and this is our guarantee:—

That any union bearing our trade mark ☞ DART will give absolute satisfaction or be replaced TWO for ONE.

DART UNION CO., Limited

93-97 Niagara Street :: :: TORONTO, ONT.

The advertiser would like to know where you saw his advertisement—tell him.

THE "IDEAL" PACKLESS VALVE

Should Interest You, Mr. Engineer.

It is a valve that needs no attention, after once installed, in tbe way of packings.

Does away with expenses in keeping up an ordinary valve and prevents accidents that are liable to occur by escaping steam, water, or gas.

It is guaranteed not to leak under any pressure up to 200 pounds.

The "Ideal" Packless Valve is neat in design and construction and is made to meet the requirements of every boiler room.

We invite comparison between any of our products and those of other manufacturers whether in material or workmanship.

You will save much trouble by writing us.

The Ideal Packless Valve Co., Ltd.
WALKERVILLE, ONT.

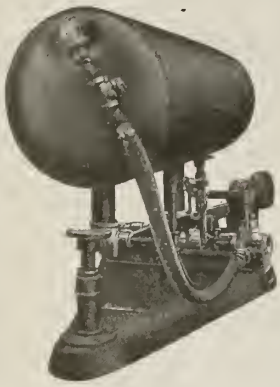
Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited
· Valve Manufacturers
WALKERVILLE - ONTARIO



The Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars

Morehead Mfg. Co.
DEPT. "J." DETROIT, Mich.

Canadian Representatives—Geo. W. Cole, c/o A. R. Williams Machinery Co., Toronto, Ont.; W. H. Markle, Montreal; Park Bros., Chatham, Ont.; W. H. Roscvear & Son, Winnipeg, Man.

ENGINEERS

Who rely on the judgment of others to a great extent do not reach the highest point attainable in the trade.

YET

it is absolutely necessary to

RELY

on other men's brains for the money-saving and safety appliances which are indispensable to the economical up-to-date steam plant. The progressive engineer of to-day looks with pleasure

ON

recommendations from fellow tradesmen, but the trial only must convince him of the efficiency of any apparatus which is to become a part of his plant.

Heat and Pressure Control Co.
603 KENT BUILDING, TORONTO

take pleasure in forwarding such recommendations from the best men in the country concering their apparatus.

—Automatic Boiler Feed Control.
—Automatic Hot Water Control.
—Automatic Steam and Stoker Control.
—Automatic Pump Governor.

No Sir, It Won't!

"Won't what?"

"Won't leak."

"What won't leak?"

"NELSON Blow-Off Valve."

"Fuddle! Leakin's a steady job for every blow-off. Never saw one that wouldn't leak."

"Neither did I, until I saw the NELSON—but it don't, and won't, and can't leak, unless you try to ruin it."

"Theory twaddle, I guess."

"Well, it was the theory that got me at first—saw it in the book—studied it all over—couldn't see how it **could** leak."

"Pshaw! What's the book-news worth? Ever see it hooked on to a boiler?"

"Yes, siree—that's the puddin-proof. Valve on 7 months—no leak—blew off once or twice a day—only part open, too; for curiosity took out the guts to see why. My word for it, Jim, there's nothing in that valve to wear out, and the packing arrangement's the simplest and slickest thing you ever saw—as good as new after shooting it off over 200 times."

"What put you wise?"

"Saw the Ad. Mailed coupon for booklet. Looked good to me. Guaranteed money back if it didn't suit after 60 days' trial. If they were willing to risk it on my line for 2 months I said there must be something to it, **couldn't lose.** The Nelson's a comer. If your Governor sees it first he'll have one on you—you'd better get a lead on him right away."

"Well, Jim, thanks for putting me on—I'll look into it myself—got the address?"

"Sure—right here."

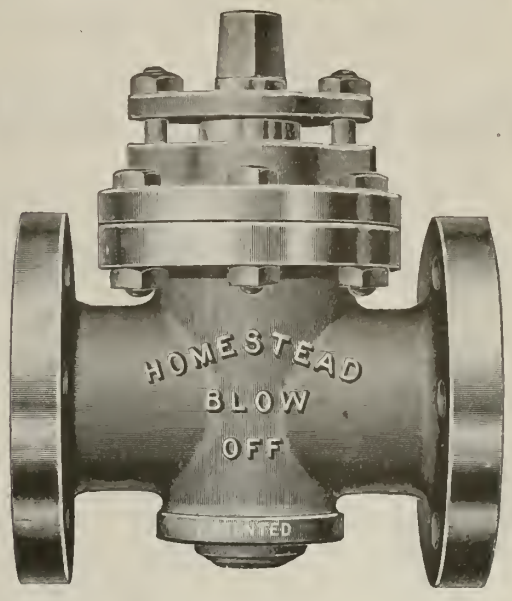
Nelson Valve Company 12-14 University St., **Montreal:**

You may send me booklet showing why your Blow-off Valves do not leak. Also quote prices.

_____

_____

_____



Homestead Valves

WILL SAVE YOU MONEY

THEY are the most durable, easily and quickly operated valves made. Homestead Valves do not leak under the highest known air or hydraulic pressure, and they have a special device which locks when closed, so that they cannot jar open.

The Seat is absolutely protected from wear when the pressure passes through, and there is no friction in the seat while plug is turning.

A quarter turn opens or closes the valve—no waste of time or energy. Why not write for our booklet to-day?

Homestead Valve Mfg. Co.

Works: HOMESTEAD, PA.

P.O. Box 1754, Pittsburg

The advertiser would like to know where you saw his advertisement—tell him.

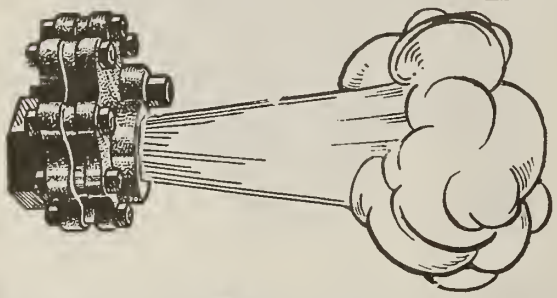
WHEN ONLY THE BEST WILL DO

Buy the "EVERLASTING" Blow-off Valve

HAVE YOU CONSIDERED THIS?

Every gallon of water leaking from your boiler costs you a pound of coal.

At least a pound.



"IT NEVER LEAKS"

ENGINEERING AND POWER HOUSE SPECIALTIES.
BRASS AND IRON VALVES.
PIPE AND FITTINGS,
FLANGED FITTINGS.
STEAM TRAPS.
PUMP VALVES, FEDRALITE.
PACKINGS.

Engineering Specialties Company

1080 King Street West TORONTO, ONTARIO

Agents: H. L. PEILER & CO., 380 St. James Street, Montreal, Que.

QUALITY

Counts in

Gauge Glasses

Bishops ADAMANT

will withstand the highest Steam Pressures and all variations of temperature.

ADAMANT GLASSES

have been tested under all conditions and have proved their superiority over all others.

Write us for Further Particulars

J. R. Baxter & Co.

Mill Supplies MONTREAL

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

W. A. CROCKETT

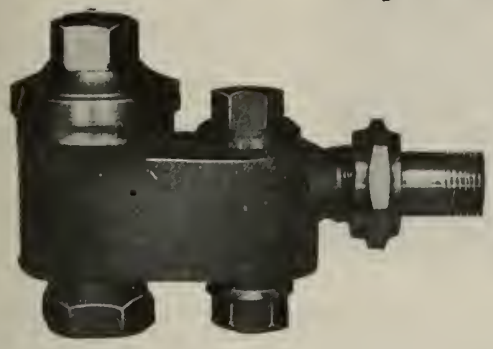
Executive Secretary

MT. HAMILTON, - - ONTARIO

The advertiser would like to know where you saw his advertisement—tell him.

THE "ECONOMIC"
VACUUM VALVE

Insures Maximum Heating Effect from Radiation By PERFECT CIRCULATION



The vacuum valve is strictly up-to-date in every respect, and by a single operation you can attach it to the old gravity type of heating apparatus, keeping the radiators always hot, with an economy of fuel consumption.

It has two chambers, the first one being a dirt chamber, in which the condensation is screened before entering the second chamber. The second chamber, containing the float, is a perfect valve, retaining absolutely the steam and eliminating the air and water of condensation automatically by means of the float.

The condensation chambers are simple and can be easily cleaned.

Eliminates all back pressure on engines supplying the exhaust.

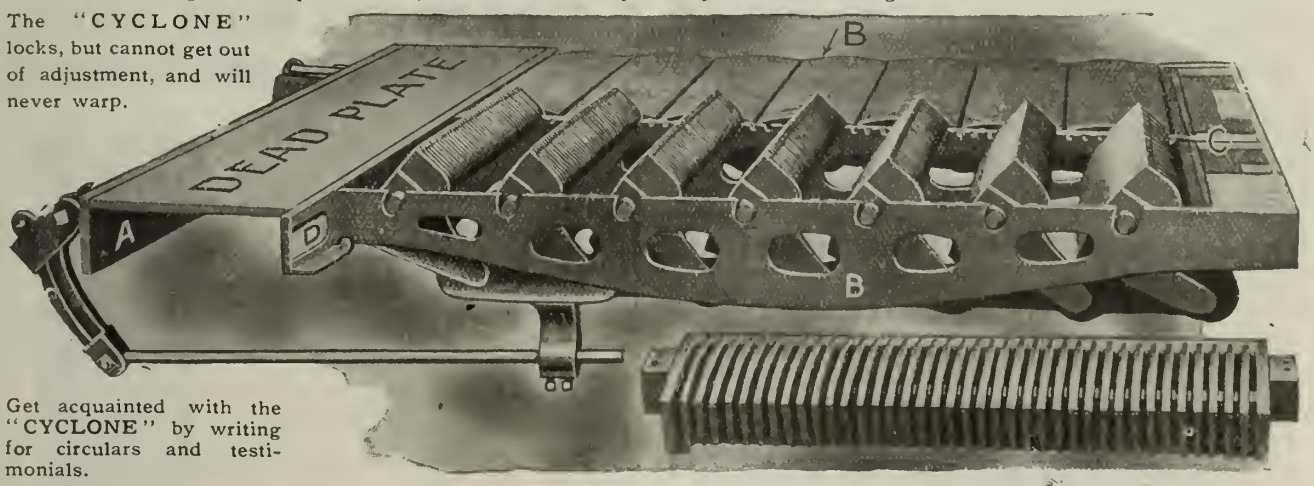
Get full descriptive matter and prices NOW. It will pay you.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.
186 QUEEN STREET EAST - - - - TORONTO, CANADA

The Cyclone Shaking and Dumping Grate Bar Will Reduce Your Fuel Bills

This is the only grate from which you can get the maximum results when burning the cheapest kinds of fuel, soft and hard coal screenings, etc. By its improved shaking mechanism, the shaking is rendered much more vigorous, and no ashes remain on the centre of the grate, the place where, in other makes, they usually are found to cling.

The "CYCLONE" locks, but cannot get out of adjustment, and will never warp.



Get acquainted with the "CYCLONE" by writing for circulars and testimonials.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.
186 QUEEN STREET EAST - - - - TORONTO, CANADA

AGENTS:—ST. JOHN, N. B., F. W. Blizzard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 38 St. James Street. HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited. BERLIN, J. Hainsworth, 14 Foundry Street.

The advertiser would like to know where you saw his advertisement—tell him.

Figure the Saving!

Figure out for yourself how much you could **save**, in **coal**, if you were using the

Vulcan Soot Cleaner

Figure it on the following basis:

Cost of Coal

Average coal consumption by average water tube boiler per day..... 10 Tons
Three hundred working days per year..... 3,000 "
Cost of Coal at $3.00 per ton.....$9,000.00

Estimated Saving

By keeping the tubes absolutely clean with the Vulcan you save at least..... 5 per cent.
5% on $9,000 ..... $450.00

Cost of Vulcan

Average cost of Vulcan Soot Cleaner per water tube boiler..... $275.00

Returns on Investment

Average returns on the first cost of Vulcan, per year..... over 150 per cent.

Actual Saving

Evaporative tests with the VULCAN frequently show an increase in evaporation of 8 to 10 per cent.

The Vulcan for Fire Tube Boilers costs only $55. Guaranteed to pay for itself in six months.

In fact, the Vulcan Soot Cleaner produces more economy per dollar invested than any steam appliance connected with power plant practice. **That's why over 50 per cent. of the Vulcan business to-day is repeat orders.**

You know *your* plant—just figure what an annual five per cent. saving on *your* coal bill would amount to—then remember that the Vulcan is a guaranteed proposition—you risk nothing. Can you afford *not* to investigate? The facts are here—our booklet "Economical Steam Production" tells the whole story and gives much valuable data about soot and its removal.

A copy is yours for the coupon. Mail it now.

Vulcan Tube Cleaning Systems, Limited

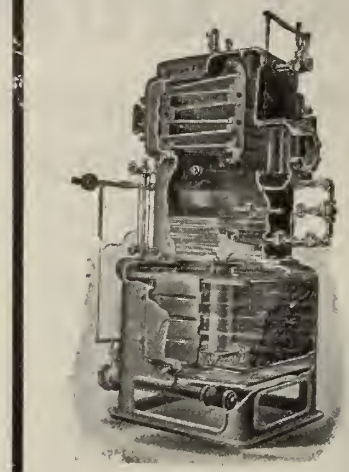
Factory and Home Office:
4-11 Bonsecours St., -:- MONTREAL.

SIGN, TEAR OUT AND MAIL

Power House, Feb. 12, *Date*.....
Vulcan Tube Cleaning Systems, Limited,
4-11 Bonsecours St., Montreal.

Please send us, without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.
(It is important that following information be given in full.)
Water Tube Boilers. Number.....Type.....Pressure.....
Horsepower.....No. Tubes High (except on Stirling boiler).....
Any Superheaters.....Width of alley space at side.....
Tubular Boilers. Number.....Horizontal or vertical.....
Name.....
Address.....

A Pure Boiler Feed Water Is Essential to Economy



You can't get over the fact that impure water will soon interfere with the efficiency of your boiler and seriously add to your fuel consumption. There is only one way to insure boiler efficiency and fuel economy---that is, purify your boiler feed with a

WEBSTER FEED WATER HEATER, PURIFIER and FILTER.

Let us make one specially suited for the feed water used in your boilers. Almost every case calls for special treatment. Our capacity and experience is indicated by the fact that over 3,000,000 h.p. of Webster Heaters are in use to-day.

WRITE FOR LITERATURE

Darling Bros., Limited

15 Ottawa St. - MONTREAL, P.Q.

Toronto, Ont. St. John, N.B. Winnipeg, Man.
Vancouver, B.C., Frank Darling & Co., Agents.

YOU CAN SAVE MONEY

BY USING

The "OTIS"

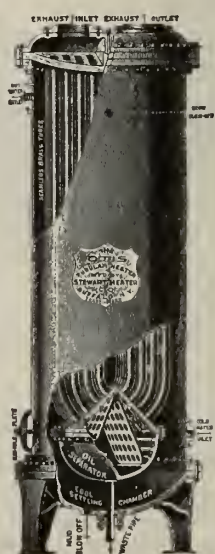
TUBULAR FEED WATER HEATER, OIL SEPARATOR AND PURIFIER

The "OTIS" is a marvel of simplicity and is built to withstand the most severe usage, having no parts that are liable to get out of order.

It will save enough fuel to pay its cost many times over.

The exhaust steam, after passing through this heater, can be used for further heating purposes, as the heater extracts all oil from the exhaust.

The "OTIS" means economy to you. Write for catalog, as it is fool-proof.

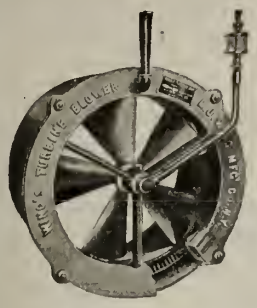


THE

Stewart Heater Co.

189 Norfolk Ave.
BUFFALO, N.Y., U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.



Exterior View
Blower Complete

You Can Save at Least 25 per cent. on Your Annual Fuel Requirements by Using the

"Typhoon" Turbine Blower

System of Mechanical Draft.

Will save money because the cheapest grades of fuel can be used, saving from 75c. to $1.00 per ton.

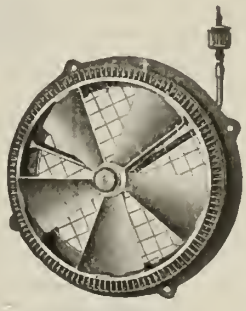
This blower can be automatically controlled, so that it will stop and start with the rise and fall of steam pressure—an almost constant pressure is consequently maintained.

The "Typhoon" Turbine Blower

produces a **powerful forced draft,** which passes under the grate and gives a combustion that cannot be equalled by any natural draft, or any other mechanical draft. It will greatly increase the efficiency and capacity of any boiler. Will operate with any pressure above 25 lbs. Low in first cost—economical in operation.

We guarantee the results. Write us at once for full information.

Send for Catalogue.



Interior View
Casing Removed

The Standard Engineering Company, Limited

14-16 King Street East, - - - TORONTO

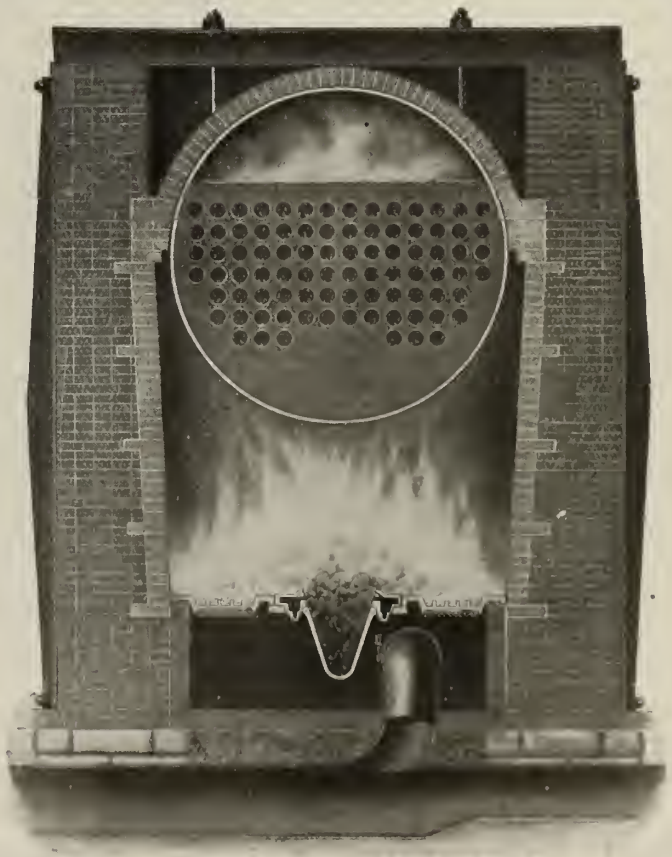
NO LOSSES

THERE are no grate bars in a Jones stoker, consequently NO LOSS of fuel through the bars.

The gases are driven off the coals and mixed with air ***beneath*** the fuel bed, pass through the fire, are brought up to the ignition temperature and consumed, consequently NO LOSS in unburned gases! NO SMOKE!

Utilizing the fuel with a minimum of loss, and with the automatic regulation of the steam pressure by the steam pressure itself, make a Jones Underfeed Stoker installation an ideal system of firing a steam boiler plant.

Let us tell you more about it.



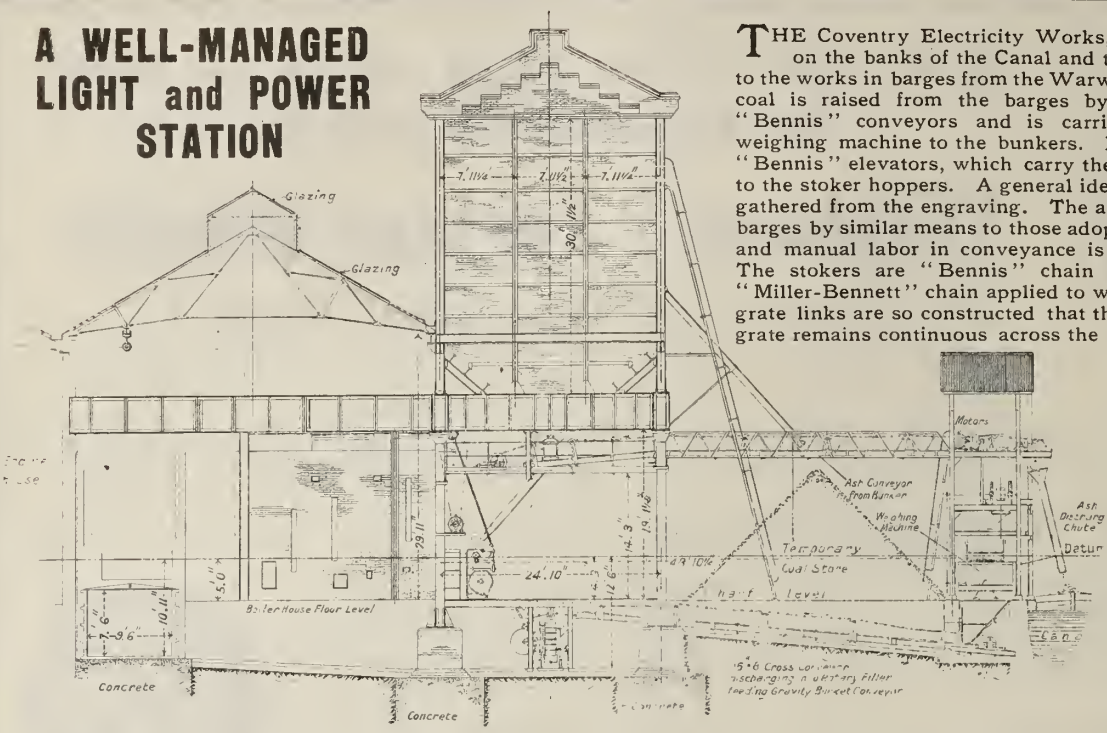
Jones Underfeed Stoker Co., Limited

National Trust Building
TORONTO

Coristine Building
MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.

A WELL-MANAGED LIGHT and POWER STATION



THE Coventry Electricity Works, England, are situated on the banks of the Canal and the coal used is brought to the works in barges from the Warwickshire coalfields. The coal is raised from the barges by mechanically-operated "Bennis" conveyors and is carried over the automatic weighing machine to the bunkers. In the boiler house are "Bennis" elevators, which carry the coal from the bunkers to the stoker hoppers. A general idea of the scheme will be gathered from the engraving. The ashes are returned to the barges by similar means to those adopted for raising the coal, and manual labor in conveyance is reduced to a minimum. The stokers are "Bennis" chain grates, fitted with the "Miller-Bennett" chain applied to water-tube boilers. The grate links are so constructed that the upper surface of the grate remains continuous across the junction of each pair of links, and there is, therefore, no opening into which ashes or clinkers can fall, or an excessive quantity of air gain admission. A second advantage with the "Bennis" link is that the fuel can be fed on to the furnace at any point, thus giving greater available grate surface for combustion. The *Engineer*, writing on this plant, says: "We have had an opportunity of examining an independent report upon a boiler test carried out at Coventry, which indicates that excellent results are being obtained with the plant." The Coventry Electric Station is one of the best managed in the U.K., and, as might be expected, both fuel costs and working costs are at a minimum.

Write for **Boiler-House Economy in Industrial Undertakings** pamphlets to Ed. Bennis & Co., Ltd., Works: Little Hulton, Bolton, Lancashire, or to

G. H. TOD, 213 Manning Chambers, Queen Street West, Toronto

Water Softening, Filtration and Purification

For Boiler Feed and Manufacturing Purposes

The sources of financial loss from the use of impure water for Boiler Feed purposes are: *Incrustation, Corrosion and Foaming*, all of which mean:

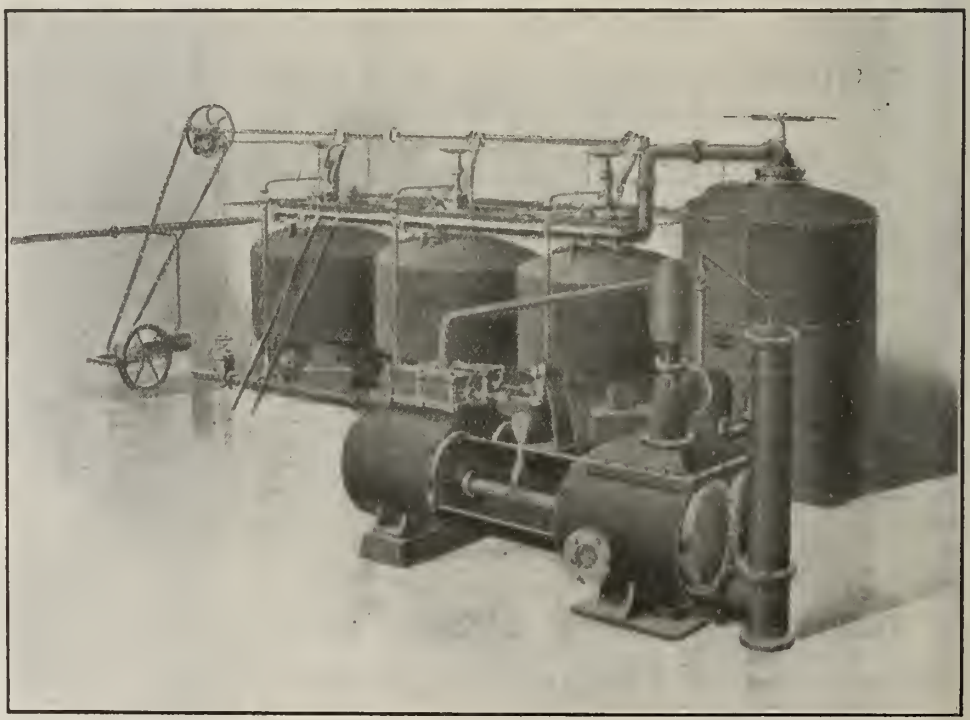
Increased Cost of Fuel
Increased Boiler Repairs
Increased Time for Boiler Cleaning
And Shorter Life of Boiler

Prominent features of the BELL FILTRATION PLANT are its reliability of purpose and operation; its requirements of the minimum attention, its ability and capacity to obtain softness and purity of the hardest and most highly contaminated water, so that steam and other boilers may be kept entirely free from deposit and scale.

A conservative estimate places the average loss of fuel efficiency at 13% for every 1-16 inch of scale on heating surface. This applies equally to locomotive, stationary and heating boilers, whether soft or hard coal is used for the generation of steam.

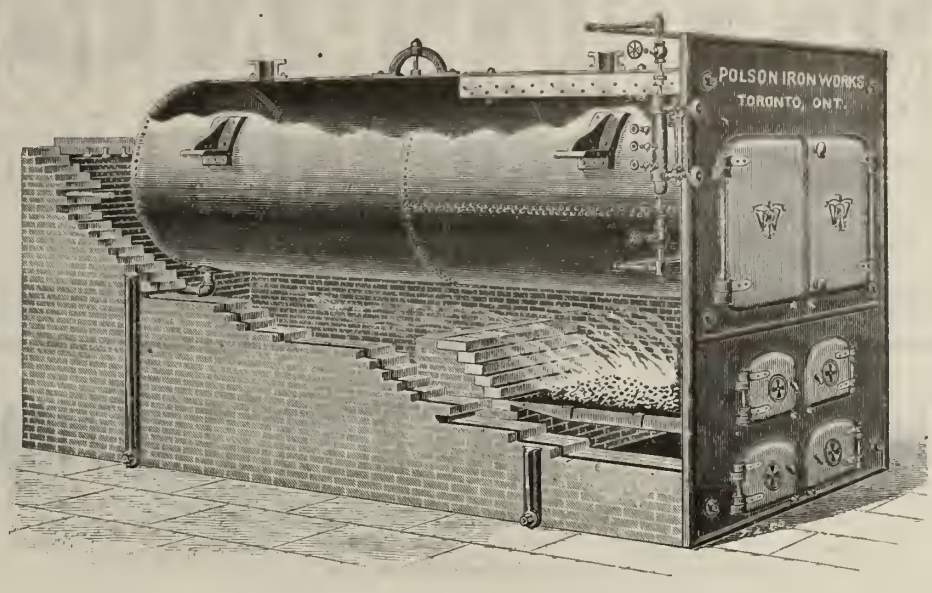
Manufactures, such as Bleaching, Dyeing, Brewing, Distilling, Sugar Refining, etc., are assured of the highest degree of purity of their various products.

The Filters are equipped so that they may be washed out each day or oftener, the operation involving only from 3 to 5 minutes. This ensures the filter sand being kept sharp, clean and effective, without which it is otherwise useless.



Water Softening and Filtration Plant erected for a firm of Dyers and Bleachers. Capacity 600,000 gallons per 24 hours.

Bell Filtration Co. of Canada, Limited, Head Office, 305 Kent Building, Toronto - - Canada



HORIZONTAL
RETURN TUBULAR BOILERS

BUILT FOR ANY PRESSURE DESIRED. BUILT TO PASS INSPECTION IN ANY PROVINCE. ARRANGED FOR ANY SETTING REQUIRED, WHETHER IT BE STANDARD, DUTCH OVEN, OR SPECIAL. BOILERS WILL BE BUILT TO REST ON BRICKWORK, OR FOR SUSPENSION FROM GIRDERS AND BEAMS.

THE BEST MATERIAL, MANIPULATED BY EXPERIENCED WORKMEN, ENSURE A FIRST CLASS BOILER.

We Employ Both. ***Consult Us.***

POLSON IRON WORKS, LIMITED

STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

TORONTO **CANADA**

REPRESENTATIVES IN CANADA FOR

The B. F. Sturtevant Co., Hyde Park, Mass., U S.A., Fans, Blowers, Heating and Ventilating

The John I. Thornycroft Co., London, England, Marine Motors

THE LINDE CANADIAN REFRIGERATION CO.,

LIMITED

C. W. VOLLMANN, President

MANUFACTURERS OF

"THE LINDE"

Refrigerating and Ice-Making Machinery

We are the same Company which, under our old name of the Linde British Refrigeration Co., Limited, of Canada, has manufactured and installed all the Linde Refrigerating Machines in Canada during the last 16 years.

HEAD OFFICE:
37 St. Peter Street
Montreal

BRANCH OFFICES:
TORONTO: Imperial Chambers, 32 Adelaide Street East
WINNIPEG: 110 James Street
EDMONTON: 562 Second Street
VANCOUVER: Imperial Block, Cor. Pender and Seymour Sts.

THE LINDE BRITISH REFRIGERATION CO., LIMITED

ESTABLISHED 26 YEARS.

HEAD OFFICE, 35 Queen Victoria St., London, E.C.

DIRECTORS :

PROF. C. Von LINDE.
C. Von LANG PUCHOFF,
K. S. MURRAY,
R. C. GRANT,
G. H. LLOYD, Chairman,
T. B. LIGHTFOOT,
Managing Director

TRADE
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BRANCHES:

CALCUTTA
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PORT NAPIER, N. Z.
JOHANNESBURG, S. A.
MONTREAL

OVER **8000** MACHINES SOLD

for every purpose requiring

MECHANICAL REFRIGERATION

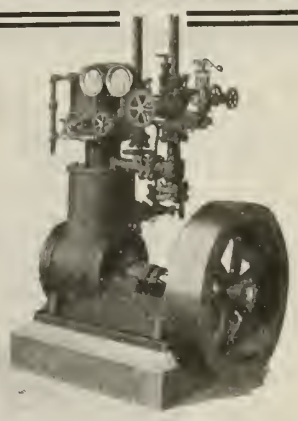
628-9 CORISTINE BUILDING, MONTREAL, P. Q.

ESTABLISHED 1867

THE VILTER MANUFACTURING CO.

242 BECHER ST., MILWAUKEE, WIS., U.S.A.

A small machine for small Ice-making and Refrigerating Plants, as well constructed and as successful in operation as larger outfits. VERTICAL SINGLE ACTING AMMONIA COMPRESSORS, different sizes. Built with fewest possible number of parts. Sold at low price. Excels all others of like size in every point—simplicity, efficiency, reliability, smoothness of action, etc. We build horizontal and vertical ICE-MAKING AND REFRIGERATING MACHINERY, a full line of CORLISS ENGINES. and MACHINERY FOR BREWERS AND BOTTLERS. Our plant covers more than eight acres of ground.



Vertical Single-Acting Ammonia Compressor, Enclosed Type for Belt-drive

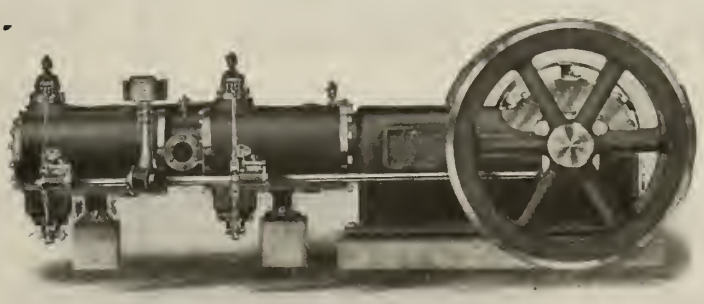
Type E.S.T.

--NOTICE THE CROSSHEAD--

Gas Engines for Perfect Regulation

Built like High Grade Steam Engines

Single and Double Tandem. A power impulse every stroke.



The GENERAL MACHINERY CO., Limited

526-7 Traders Bank Building, - - Toronto

The advertiser would like to know where you saw his advertisement—tell him.

IMPERIAL ENGINES ARE MADE HERE

IMPERIAL ENGINES ARE USED EVERYWHERE

IMPERIAL Gas, Oil and Gasoline ENGINES

Are Now Unequalled

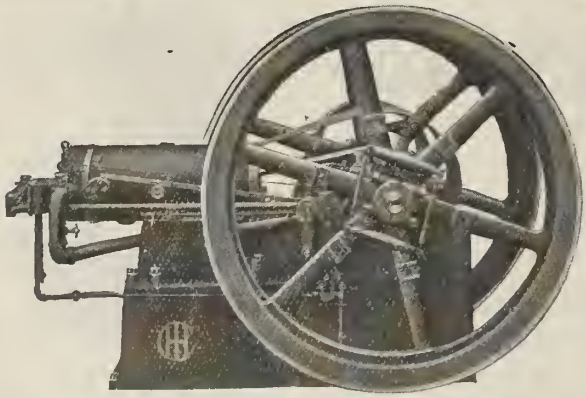
Invented and Manufactured by the

KEIGHLEY GAS & OIL ENGINE CO.,
LIMITED
KEIGHLEY, - - ENGLAND.

Sole Selling Agents for CANADA

H. W. PETRIE, Ltd.
Machinery Experts,
TORONTO, - - ONTARIO.

CATALOGUE and PRICES on application.



1 to 50-H.P.—And Every One Reliable

Wherever you have occasion to use a compact, self-contained, economical prime mover, install an I H C Gasoline Engine.

There is an I H C Engine of a style and size to meet every power requirement. Each size in each style has stood the rigorous tests necessary to merit the I H C trade mark.

From 1 to 50-H.P.—water cooled or air cooled; horizontal or vertical; stationary or portable; and tractors from 12 to 45-H.P. —offers you a complete line of the world's best engines to select from—eliminating all risk. I H C Engines are built to operate on gas, gasoline, kerosene, distillate or alcohol.

For catalogue and complete information, address

International Harvester Company of America
(INCORPORATED)
50 HARVESTER BUILDING, CHICAGO U S A

THE
CANADIAN CASUALTY
AND
BOILER INSURANCE
COMPANY

SPECIALTY:

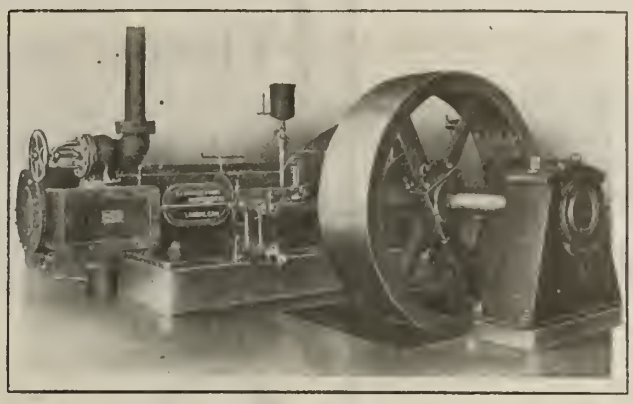
Boiler Inspecting, Reporting, Insurance, Evaporation Tests

CONTINENTAL LIFE BUILDING
TORONTO

J. O. B. Latour
Chief Engineer.

John J. Durance,
Manager.

Phone Main 6941.



Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY

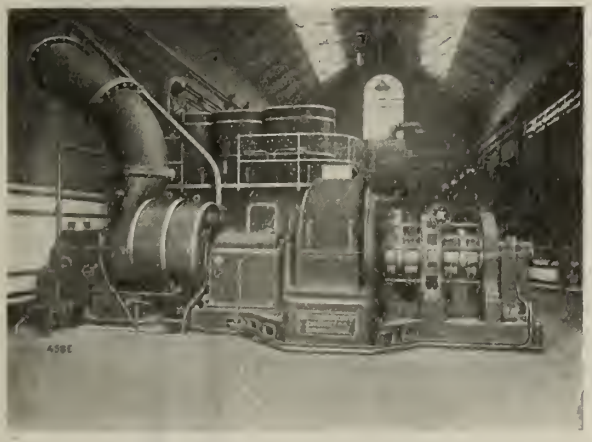
E. LEONARD & SONS, LONDON, ONTARIO

MANUFACTURERS OF

High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants.

WAREHOUSES AND AGENCIES AT

MONTREAL, ST. JOHN, N. B., CALGARY, WINNIPEG, VANCOUVER



Reciprocator and exhaust steam turbine combination, Darlington Corporation Electricity Works.

Belliss & Morcom

Exhaust and Live Steam

Turbines

MANUFACTURED BY

Messrs. Belliss & Morcom, Limited, of Birmingham, Eng.

Similar turbines at Bullcroft, Nostell, Burslem, Ebbw Vale, H. M. Dockyard, Chatham; Lowmoor, Cadzow, Colville's, Hayle, Prestea Block A, Australia; London, Birmingham, etc., etc.

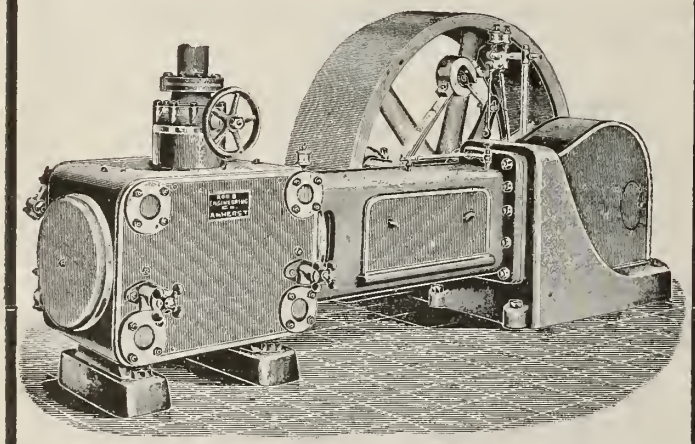
Waste Steam Utilization—At plants where considerable steam at atmospheric pressure is continually going to waste, as in Rolling Mills, Collieries, etc. When additional power is required, a Belliss exhaust steam turbine should be installed, which would utilize the exhaust steam without the necessity of installing additional boiler capacity.

Sole Canadian Agents

Laurie & Lamb, 211-212 Board of Trade Building Montreal

Robb-Armstrong Corliss Engines

have triple-ported valves of the Corliss type, but a more simple valve gear.



The valves close quickly and positively because there are no springs, dash pots, or disengaging parts which sometimes fail to operate on time.

The cut-off is controlled by the direct action of the governor, not by the indirect action of spring releasing gear.

The shorter stroke and compact frame eliminate the vibration always found in long stroke, girder-frame engines.

Robb Engineering Company, Limited

WORKS:
AMHERST, N.S., CANADA
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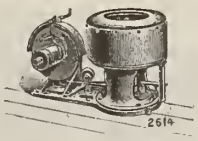
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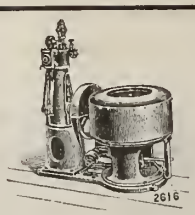
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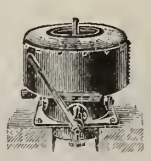
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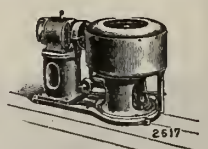
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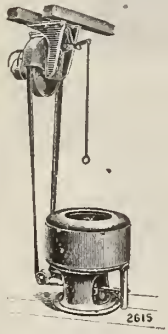
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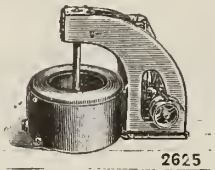
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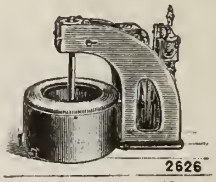
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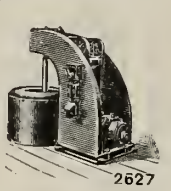
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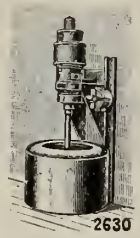
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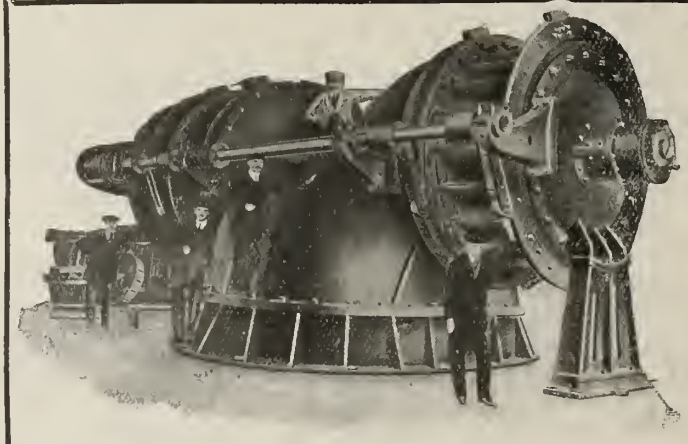

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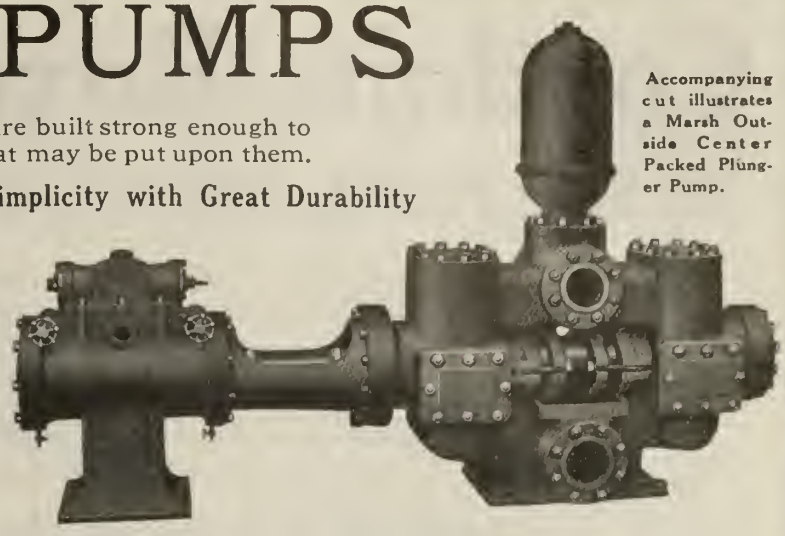

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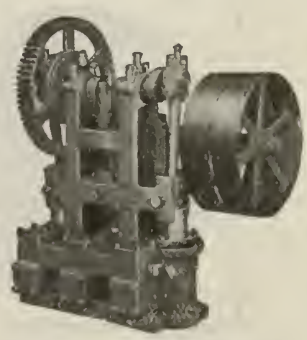

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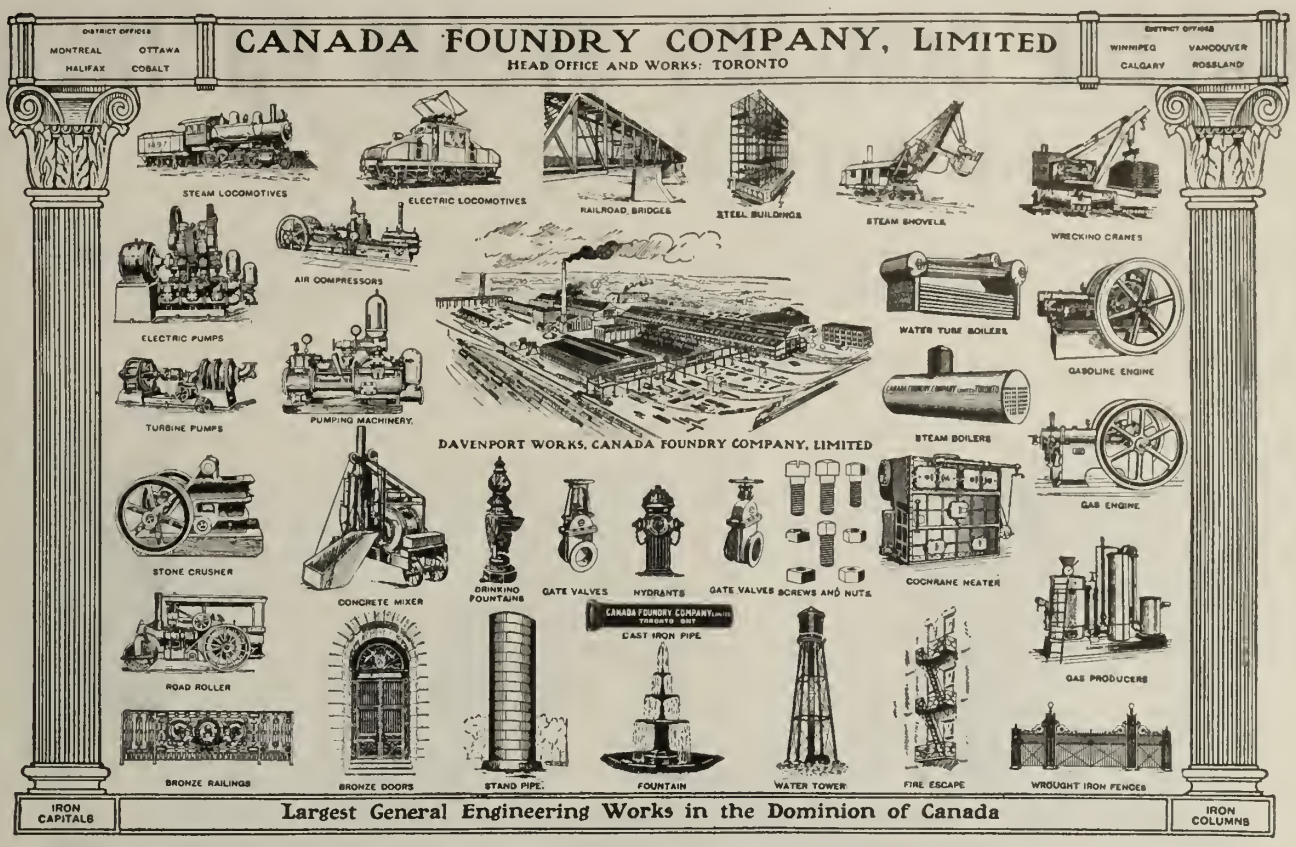

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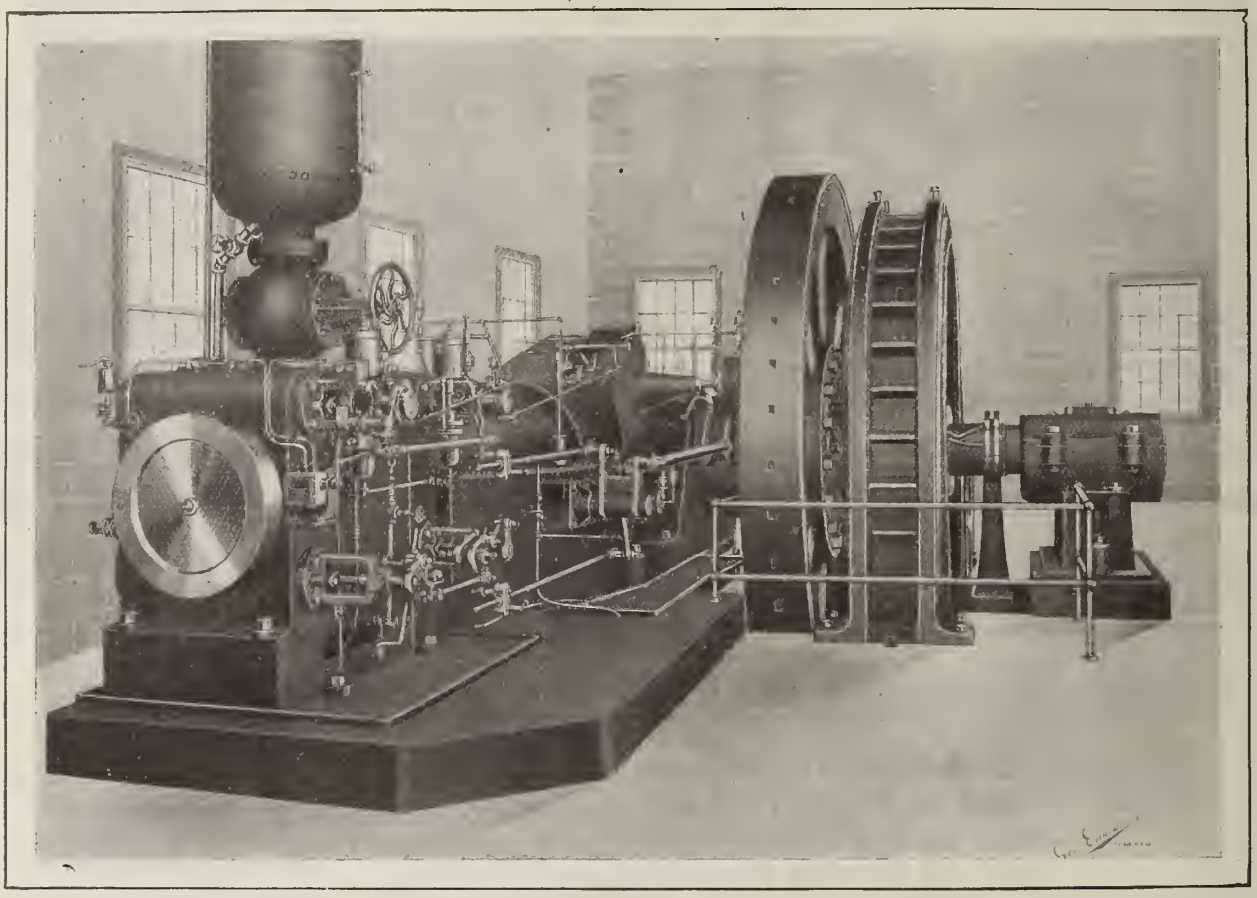

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Evolution and Present Development of the Turbine Pump*

By Dr. Edward Hopkinson and Alan E. L. Chorlton

This article shows that the present high attainment in design, constructional detail and service efficiency of turbine pumps has been no mushroom growth, but the gradual outcome of persistent application to the various problems involved, and the evolution by test, experiment and calculation, of ideas leading to their solution, over a somewhat extended period of years. Turbine pumps have been installed in many plants throughout Canada by a number of different makers, and we believe the subject to be full of interest to every manufacturer, customer and operator of these machines.

TO-DAY, the turbine principle seems to be the accepted ideal of almost all primary machines. It would appear that the age of the reciprocating engine, for the various duties of mechanical engineering, is passing, and that the rotary engine of the turbine type is steadily taking its place. In that of steam prime-movers, it has, perhaps, already taken the lead over the reciprocating type, and the engine of Watt must now he relegated to second place. In other fields and duties its progress to date is so great as to warrant the surmise that at no distant time a similar comparison of precedence will he made. In no domain, perhaps, has the turbine rotary principle achieved greater success in the last few years than that of high-lift pumping, though the realization of its possibilities for such duties, by some, is perhaps as old or older than the steam-turbine itself. Still its general acceptance as correct engineering practice is only a matter of the last five years.

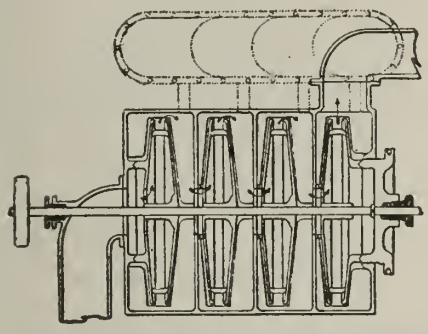
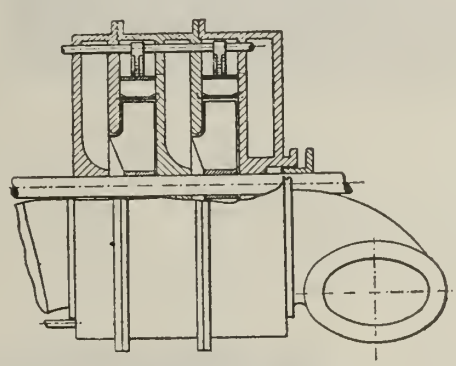


Fig. 1.—Centrifugal Pump. (John Gwynne) 1851.



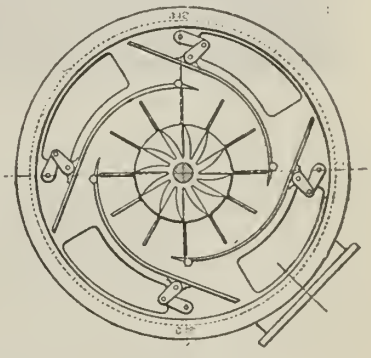


Fig. 2.—Turbine Pump. (Osborne Reynolds, 1875.)

At the present time, the use of the Turbine-Pump has become so extended that it is difficult to find services to which it cannot be advantageously applied. It will, no douht, therefore, he a matter of interest to trace the evolution and development of machines of this design, and this, perhaps, cannot be better done within the limits of a single Paper and the time availahle, than by considering in particular one type only, and that the authors believe to he the original. As a description of the commercial application of the steam-turbine is a history of the Parsons machine, so that of the turbine-pump can be adequately portrayed by an account of the evolution of the Oshorne Reynolds Pump.

Evolution of the Turbine Pump.

The rotary machine for raising water in the form of a centrifugal pump is a very old contrivance, and was the forerunner of pumps of the turbine type. At the heginning of the eighteenth century, Denis Papin, the French physician and physicist, afterwards a Fellow of the Royal Society, communicated to the Society a Paper in which he describes how "being busy for a coal mine, which has been left off, because of the impurity of the air," he had devised improvements in the Hessian bellows with a view to applying them both to wind and water. His improved apparatus consisted of radial wings caused to revolve ahout an axis in a cylindrical chamher of which the portion external to the wheel was of a spiral shape. His drawings show clearly the volute casing of the modern centrifugal pump. Papin had no means of driving his fan or pump other than by hand power, and more than a century elapsed before his ideas were applied in practice.

Centrifugal pumps were in the past accepted hy engineers as suitahle appliances for easily and cheaply (as to first cost) raising water to low heads. It was not realized that they were capable of dealing with any but such heads; in fact, such a view became a canon of ordinary engineering practice, creating

* Paper read before the Institution of Mechanical Engineers, London, January, 1912.

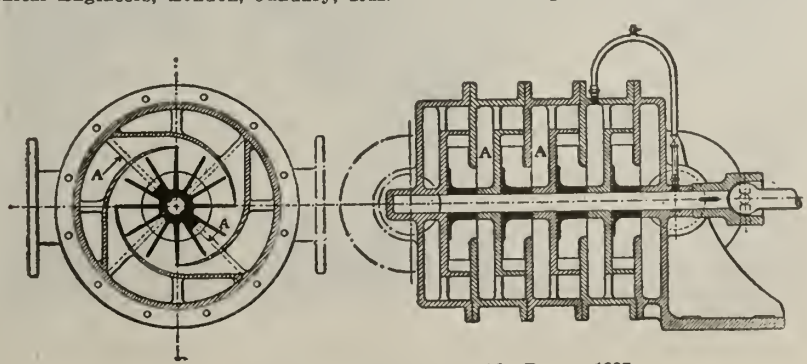


Fig. 3.—Osborne-Reynolds Pump, 1887.

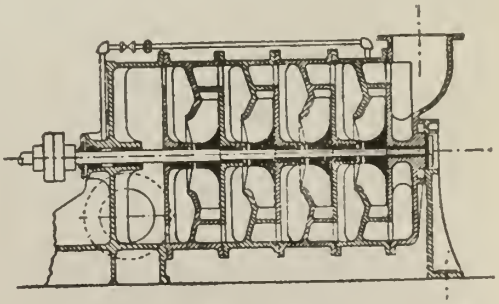


Fig. 5.—Mather-Reynolds Pump, 1895.

a tradition which took many years to remove. That this opinion was not universal is shown at a very early date by the omnibus patent of John Gwynne. Included in this invention is the design of a series centrifugal pump shown in Fig. 1.

Gwynne Pump.

Gwynne's specification contains many claims, and amongst other interesting designs he shows a reaction impeller, now

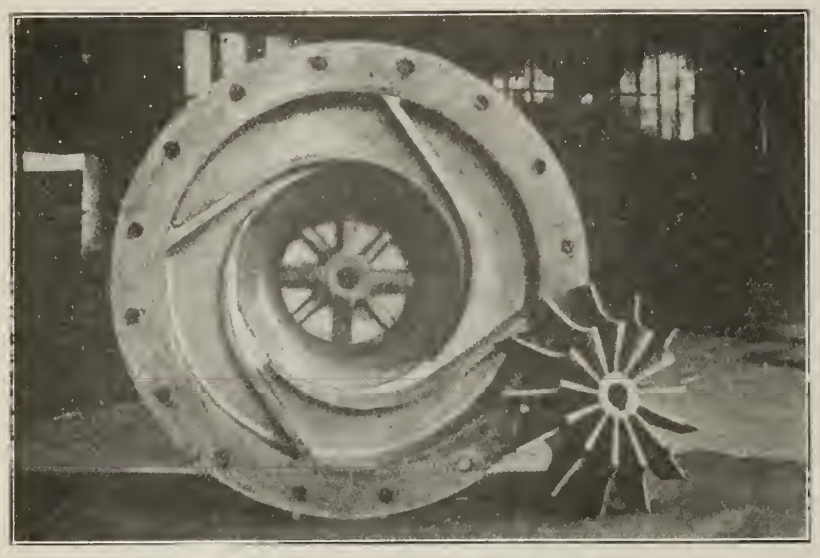


Fig. 4—Impeller and guide passages, 1895. (Mather-Reynolds).

used for self-regulation, and also a means of dealing with end-thrust. This specification seems to be the first proposal to use centrifugal impellers in series, and though in the forms shown and having no guide-vanes it could hardly be expected to attain even with low efficiency the heads now successfully dealt with, still it shows a conception of a machine very much in advance of the times. It is singular, that, though the water-turbine with its guide-vanes was a matter of common knowledge at the time, no attempt appears to have been made to reverse its action with the prospect of obtaining a similar high efficiency and increase of head, for the purpose of raising water. There was however, one exception in the invention of Professor Osborne Reynolds. It is the object of the present Paper to trace and discuss the development of this invention.

Reynolds Turbine Pump.

In the year 1875, Professor Osborne Reynolds invented a turbine-pump of the series type, fitted with guide-vanes, Fig. 2. Comparison of this figure with illustrations following show how the essential features of his original proposition have been adopted in subsequent practice. In this pump the impeller delivered its water to tangent guide-vanes, as shown in Fig. 2, and the similarity to an inward-flow turbine of the Thomson type is noticeable, for, as in that machine, the mouths of the guide-channels could be regulated to raise the efficiency of the pump for smaller outputs, a device, however seldom adopted in later practice. He claims "the arrangement and combination of two or more centrifugal pumps or fans, in which the fluid, after leaving the moving passages, is received into fixed passages, so formed as to deprive it of all velocity of whirl."

Nothing of any commercial value appears to have been done with the invention for many years; in fact, the first pump of which records and tests are available was only constructed in the year 1887 by the firm of Mather and Platt for the Engineering Laboratory of the Owens College, Manchester. This pump, shown in cross and longitudinal section in Fig. 3, had four impellers in series and gave at 1,500 revolutions per minute a total head of 148 feet or 37 feet per chamber. The average efficiency recorded in the tests made by Professor Reynolds was 58.5 per cent., a high result, having regard to its small size, for a pump made twenty-five years ago. The readings were taken from a dynamometer fixed between the pump and the belt-pulley, and, as no method of damping the indicating finger seems to have been employed, they may be liable to some error. Thus the maximum efficiency obtained, viz. 70 per cent., appears open to some doubt. The guide-vanes,

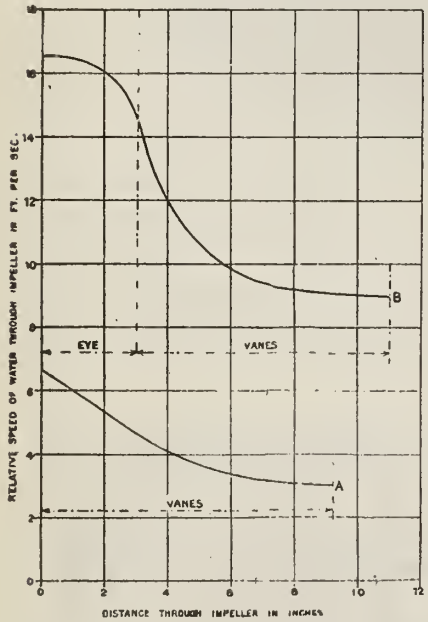


Fig. 6—Curves showing relative velocity of water through impellers, when delivering their most efficient quantity. A—Mather-Reynolds 1895 pump. B—Modern high lift pump.

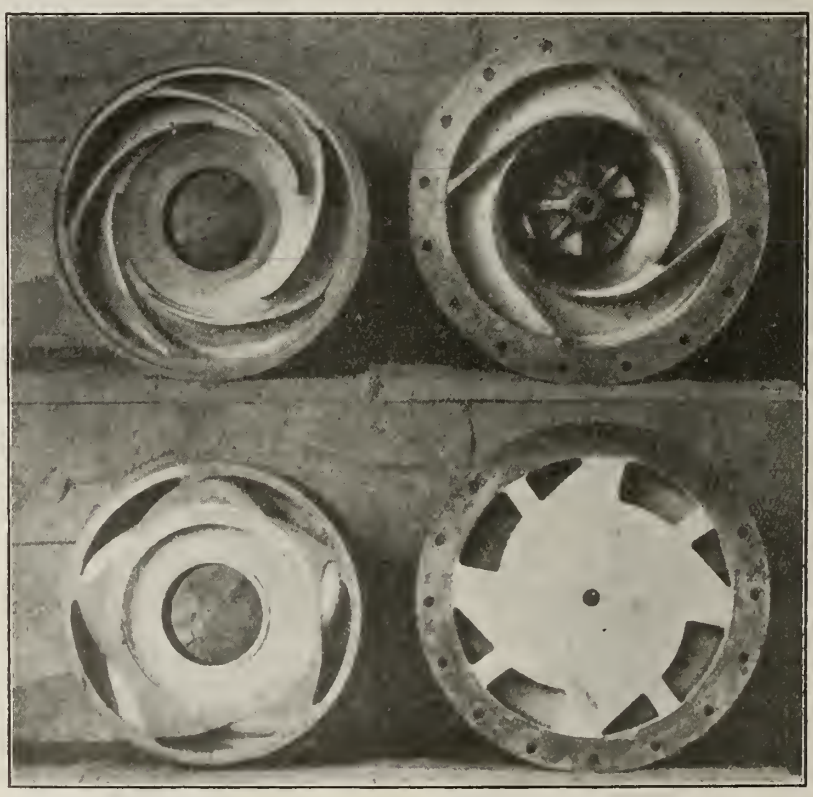


Fig. 8—Guide vanes of 1895 pump. (Mather-Reynolds) and modern pump.

after leaving the wheel in a curve, reached the inner periphery of the outer shell of the chamber at an angle. The water having had its velocity of whirl converted into pressure-head in these passages, had then to pass sideways at right angles into radial-return passages formed in the back portion of the chamber and marked "A" in Fig. 3. In these passages the water was guided and prevented from rotating by radial vanes. The water on reaching the centre passed into the eye of the second impeller, and so on until it was finally delivered at the pump outlet at the head pressure required. It will be observed from Fig. 3 that the impeller was of the open type with radial vanes. The tests of Professor Reynolds proved the capability of the pump to perform many duties, previously thought impossible by centrifugal pumps and in 1893 the firm of Mather and Platt took up its commercial manufacture.

Standard Mather-Reynolds Pump.

The mechanical construction of a standard Mather-Reynolds pump as built in 1895 is illustrated in longitudinal section in Fig. 5 and in photo, Fig. 4. It consists of four chambers working in series. At the one end, these are secured by bolts against the circular flange of a frame carrying the driving pulley or shaft coupling, this having the suction branch and entrance to the first chamber cast with it. At the other end the delivery chamber forms the final cover, and has the delivery pipe cast on the upper part connecting to the annular space into which the last set of guide-passages deliver, and at this end a suitable stay is attached to support the pump from the floor. The chambers are secured to each other by bolts through external flanges, each chamber being recessed and spigoted so as to preserve correct alignment of the whole. This forms an inexpensive design, and permits of accurate manufacture. It allows of chambers being added or subtracted for higher or lower heads. Each chamber is distinct in itself, and has on one side the guide-vanes, receiving the discharge from the impeller, and on the other the return passage to the eye of the next impeller. This return passage is walled by a diaphragm integral with the casting. The water leaving the impeller, guided by the delivery vanes, passes to the next chamber and is there guided to the eye of the following impeller. As shown in photos, Fig. 4 and Fig. 8 (right-hand side), there are four guide-passages in this particular pump and their form is clearly illustrated.

In comparing such a pump with a modern one it will be found that it is in the form of its impeller and its delivery-easing that the original Mather-Reynolds pump differed most from the present design. The impeller as shown in photo, Fig. 4, is of the open type (not shrouded), with radial vanes, the roots of which are carried across the openings of the eye into the boss, necessitating the use of a modified form of Francis entrance. This form was probably adopted in order to secure sufficient strength to drive the vanes, necessitating them being carried through full width to the boss on the pump-shaft, and not starting level with the outer diameter of the eye as now. The impeller was turned all over, and revolved a close fit in its casing, which was turned to a corresponding form. This prevented leakage and loss of efficiency by the return of the water from the tip to the suction along the impeller sides.

The reasons that induced Professor Reynolds to adopt such a radial impeller are not quite clear, as the shrouded form with curved back blades was in common use at that time, and is a more efficient and stronger type. Recent experiments of Dr. Gibson and Mr. Ryan have shown that in centrifugal pumps with open-vane impellers the frictional resistance is three to five times as great as with closed or shrouded ones, though it must be noted that these experiments were made with clearances considerably greater than obtained with the Reynolds impeller.

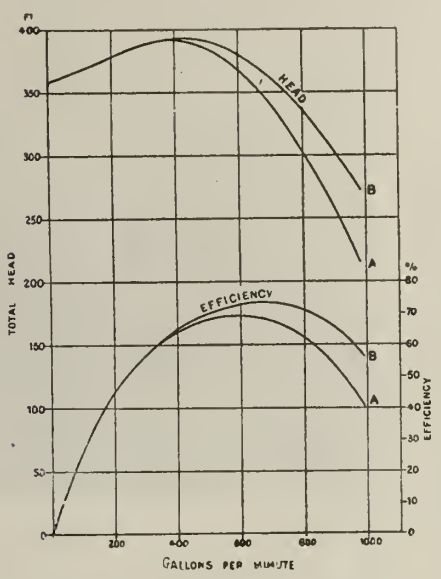


Fig. 10—Head and efficiency curves. A—Short guide passages. B—Long guide passages.

Comparison of Results with Different Impellers.

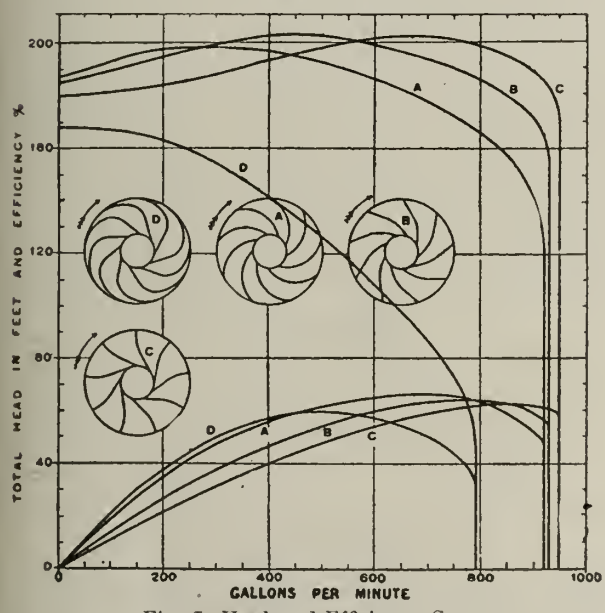


Fig. 7—Head and Efficiency Curves.

A. Head and Efficiency curves of Mather-Reynolds 1895 pump.
B. Head and Efficiency curves of modern pump.
At constant speed of 600 revs. per min.

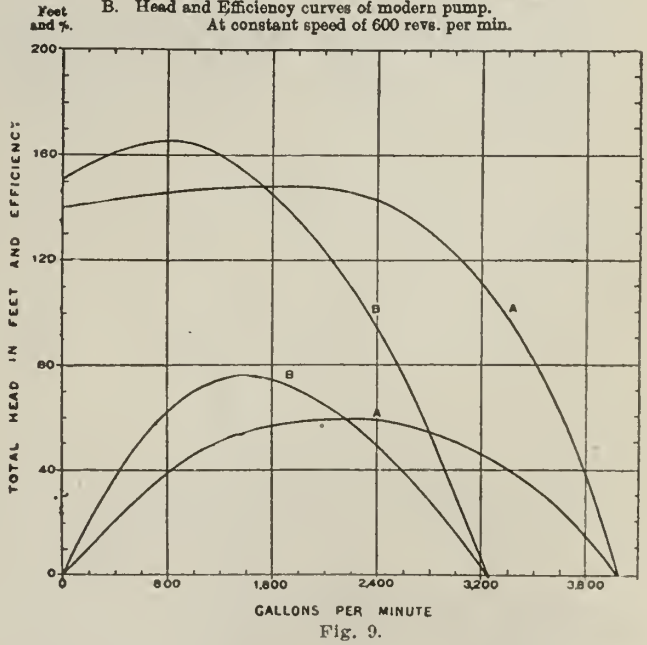


Fig. 9.

In the 1895-pumps the speeds of the water through the impeller and passage were comparatively low, and large areas were therefore necessary, see Fig. 6. Each wheel being of the open type was nearly balanced as to end-thrust in itself, and so with the moderate heads pumped against, troubles with lateral end-thrust were not experienced. There

is no doubt, however, that end-thrust did occur, and this caused the impellers to rub on the sides of their casings with consequent friction, wear causing leakage and loss of efficiency, the varying conditions of which make the true comparison of various tests difficult. This, however, did not cause any serious trouble in practice on account of the large areas on which the end-thrust was taken, and the low-head per chamber.

Fig. 7 shows curves taken on the works test-tanks from the impellers A, B, C, D, tested in the same single chamber pump body, and with one set of short guide-vanes. These impellers were not of the 1895 type, but shrouded. The curves are given solely for the purpose of showing the effect of different forms of impeller-vanes working under similar conditions. They illustrate the advantage in efficiency of the impeller with the backward curved vanes, and in head of the one with radial vanes. Impeller C most nearly corresponds to the radial vanes of Reynolds, and impeller A to the modern type. The reaction wheel D gives a gradually falling head curve as the quantity becomes abnormal, with smaller tendency to increase the driving power and lower efficiency. To obtain the best results of each impeller, different guide-passages with suitable entrance angles should have been used.

which must have a certain (long) length if serious loss is not to be occasioned by converting velocity into pressure. The difference, therefore, between the efficiency of an 1895 and modern pump, as shown in curves, Fig. 9, is probably due to the form of the Reynolds impeller and its guides with its cramped entrance at the eye with consequent shock to the entering water, and to the loss at the periphery from the radial vanes, also to the shortness or too rapid opening out of the guides. The importance of long

dimensions of entrance of the guide-passages and of the curvature and angle of delivery of the return-passages on to the eye of the impeller are shown in curves, Fig. 12. These curves have no relation to the curves of Fig. 7, being taken at an earlier date with a different pump.

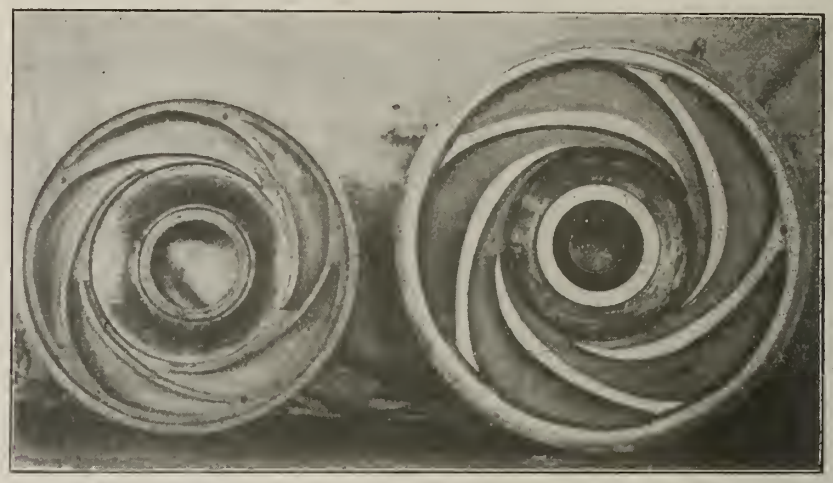


Fig. 11—Short and long guide passages. See curves A and B, fig. 10.

Head and efficiency curves are given for four different designs of guide and return passages, the same impeller of standard shrouded type being used in each case. Design A has short guide-

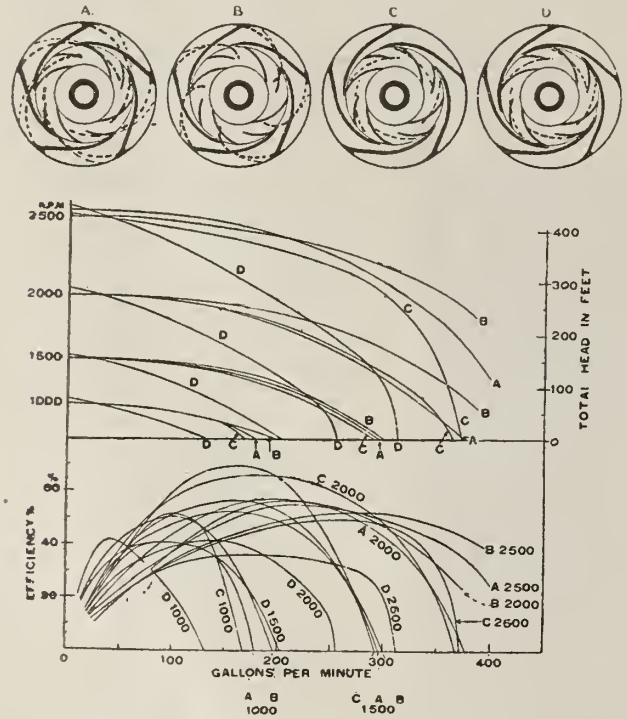


Fig. 12—Head and efficiency curves, showing effect of guide passages and return passages of different form.

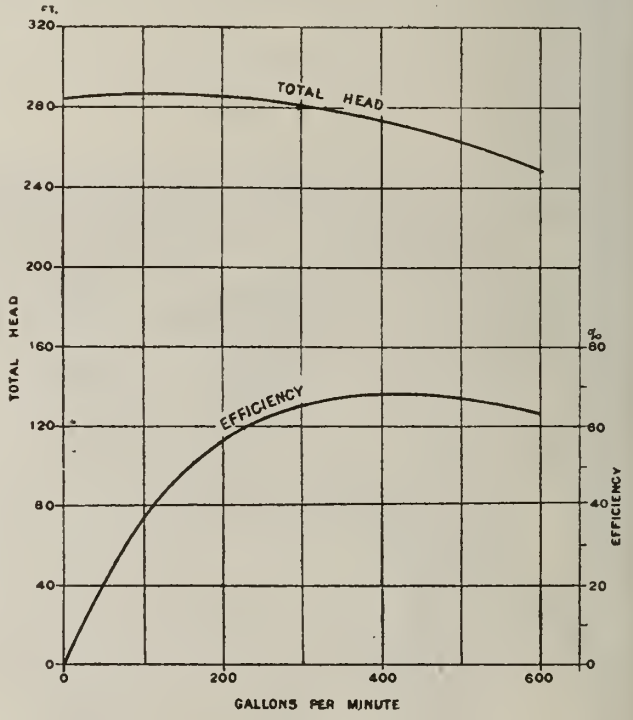


Fig. 14—Test of four-chamber turbine pump (Sulzer), when running at a constant speed of 875 R.P.M.

Considering now the guide-vanes, it will be seen that in the 1895 pump these are shorter, or rather open out quicker than in a modern pump, see Fig. 8. They are obviously less efficient if judged from the analogy of a Venturi tube, and carefully formed divergent guide-channels, is shown by curves, Fig. 10 and photo Fig. 11, the same impeller being used in each case. Fig. 11 shows photos of the short and long guide-passages.

The effect of the curvature, length and vanes with wide opening on the radial line. The return-passages are of similar curvature. Design B has similar guide-vanes, but the return-passages have a short curve becoming radial near the eye of the impeller. Design C also has

similar guide-vanes and the return-passages are similar in curvature to those of A, but are not extended to the outer periphery of the return chamber. Design D has a narrower opening on the radial line, one-half that in A, B and C. The return-passages are similar to C.

Head and Efficiency Curves.

The head and efficiency curves are given for speeds of 1,000, 1,500, 2,000 and 2,500 revolutions per minute respectively. An inspection of the curves shows that design D is much inferior both in head generated and in efficiency, due to the throttling at the throat of the guide-passages, and incidentally that self-regulation may be readily attained by such throttling, as it may also be obtained by throttling at the eye or less effectively by a reaction form of impeller, as shown in curves Fig. 7. Secondly, that design B is superior to both A and C in generation of head especially with larger quantities and superior to A in efficiency especially at the low speeds, but it is much inferior to C in maximum efficiency except at the high speeds. At these speeds eddying and whirling take place in the whirlpool chamber of C, which is prevented by the guides forming the continuous passages of design B. Design B is most usually adopted as best meeting average conditions.

Thirdly, that design C, which approaches more nearly to the conditions of a single-chamber pump, gives considerably higher maximum efficiency at speeds of 1,500 and 2,000, due to less power being absorbed by friction against the walls of the guide-passages, and also to tangential motion imparted to the water as it enters the subsequent impeller by the tangential curvature of the return passages.

Sulzer Bros.' Designs.

A considerable number of pumps of the 1895 form were constructed for installations in England and abroad, some of which are described later. Meanwhile Messrs. Sulzer Bros., of Winterthur, had commenced the manufacture of multiple turbine pumps about the year 1896, and had evolved various modifications in the Osborne Reynolds design, whereby both the efficiency and the lifting capacity were considerably improved. They had established in 1898 an interesting and novel installation of these improved pumps at the Spanish mines of Horcajo, which attracted considerable attention. Two years later an agreement was concluded between Messrs. Sulzer Bros. and Messrs. Mather and Platt, providing for an interchange of future improvements, and due acknowledgment of the original work of Professor Osborne Reynolds, and of the improvements made by the two manufacturing firms.

A four-chamber pump of the Sulzer design is shown in longitudinal and cross sections in Fig. 13. Comparing this with the 1895 design, three important differences are noticeable. Firstly, the body casting of the pump is constructed in one piece, with the intermediate pieces, guide-vanes, and impellers put in from one end. Secondly, the impellers are shrouded and have backward-curved vanes. Thirdly, the impellers are arranged back to back to compensate for the increased lateral end-pressure set up by the higher heads worked against. This arrangement of the impellers involved the use of somewhat tortuous passages in the pump to bring the discharge of the first impeller to the eye of the second, and so on. Moreover, these passages passing several joints increased the probability of internal leakage from one stage to another. Curves of head and efficiency of such a pump are shown in Fig. 14.

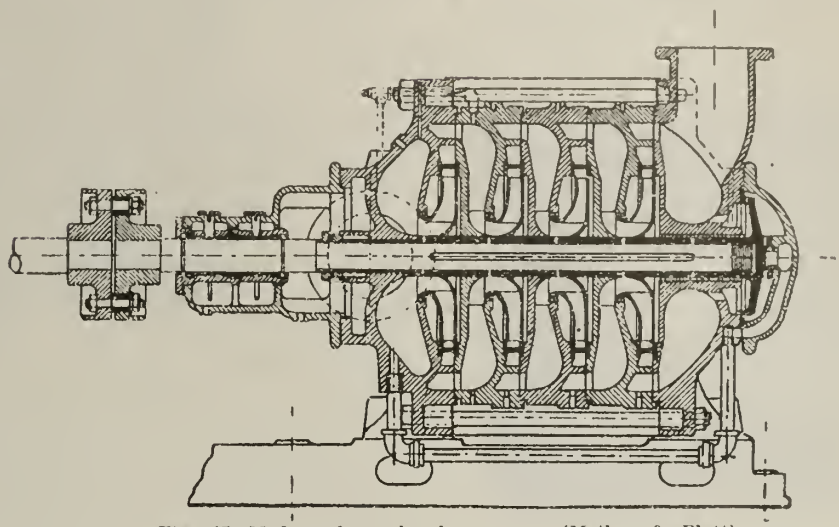


Fig. 15—Modern four chamber pump. (Mather & Platt).

The agreement between Sulzer Bros. and Mather and Platt came to an end by mutual consent in 1904, and after

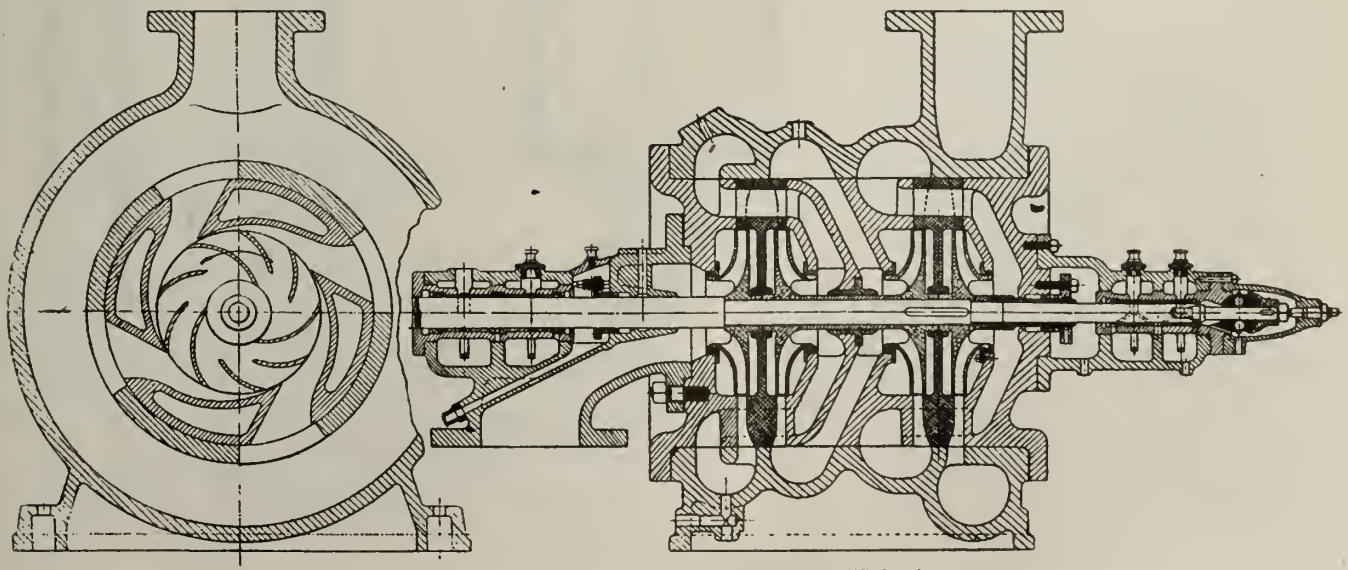


Fig. 13—Four chamber high lift centrifugal pump (Sulzer).

that date each firm further developed their pumps on their own lines. The authors deal now only with the improvements of Mather and Platt, not having knowledge of Messrs. Sulzer's work beyond what is generally available through publication.

Mather & Platt Improvements.

Proceeding now to the discussion of later designs, a four-chamber pump is

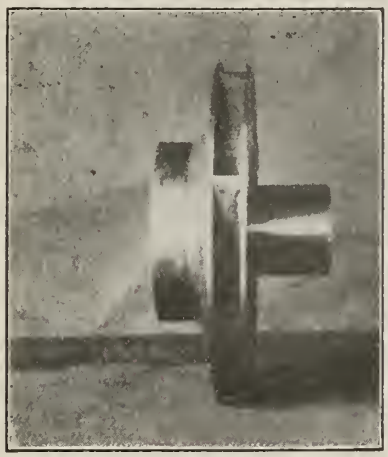


Fig. 16—Impeller of modern four-chamber pump. (Mather & Platt).

shown in longitudinal section, Fig. 15, its guide-vanes in Fig. 8 (left-hand side), and its impeller in photo Fig. 16. It will be seen that constructionally this pump differs principally in that the extended suction-end is shortened, and is similar to the delivery-end. This enables various classes of drives, motor, belt, or steam-turbine, to be better negotiated with a standard pattern. Successive chambers, instead of being secured to their neighbors by bolts and flanges, are held together by long bolts extending the entire length of the pump body, and held only at the two ends (suction and delivery). This construction secures amongst other things some economy in manufacture.

The impeller is of the shrouded type, having vanes bent well backwards, and the guide-passages are longer and more correctly divergent, whilst the return-way to the eye of the next impeller is of a curved form and more in line, and continuous with the receptive ports, thus preventing the abrupt right-angle turn through the casing obtaining in the Reynolds pump. The losses in the Reynolds impeller through side friction in its casing are obviated, and any leakage from the periphery back to the suction is prevented or greatly minimized by the outer circumference of the impeller eye running in neck bushes with a very small radial clearance, amounting to less than 0.005 inch. The importance of preventing this leakage is very great if high efficiency is to be secured. The impeller is turned all over outside to reduce loss by skin friction, and with the same object it is usual to have as many wheels as circumstances will otherwise allow.

The end or axial balance of the impellers is obtained by the automatic device shown, which acts well in practice, and compensates for wear and variable leakage taking place in the pump. In other respects the arrangement, direction of flow of water, and assemblage of the pump are the same as in the original Mather-Reynolds pump.

Representative curves of head and efficiency of such a pump are shown in Fig. 9.

Installations.

Bore-hole Pump. 1897.—This pump installation is particularly interesting on account of its novelty. The pump consists of six chambers in series and is arranged to work suspended in a bore-hole at a depth of 100 feet below the surface; it has a capacity of 850 gallons per minute, with a lift of 170 feet, and runs at 1,000 r.p.m.

The general arrangement of the rising main by which the pump is suspended is shown in Fig. 17. The pump and main rest on a crutch pipe at the bottom of the bore-hole. The pump is specially designed to fit the bore-hole lining tube, and its overall diameter is necessarily reduced. It is driven by a vertical shaft passing down the centre of the rising main and supported at each pipe-joint by suitable stay bearings. At the surface this shaft is arranged with double bevel-gears and pulleys driven from a steam-engine.

An interesting feature of this installation is shown in the illustration immediately below the pump, consisting of an expanding plug which effectively stops out all objectionable surface water allowing the supply desired to come in through the suction pipe suspended below. This pump has given continuous service for over fourteen years, during which time

Fig. 16—Impeller of modern four-chamber pump. (Mather & Platt).

it has received no repairs. In fact it has only once been brought to the surface during this period, when a portion of the shaft in the bore-hole was found to be corroded and required renewal.

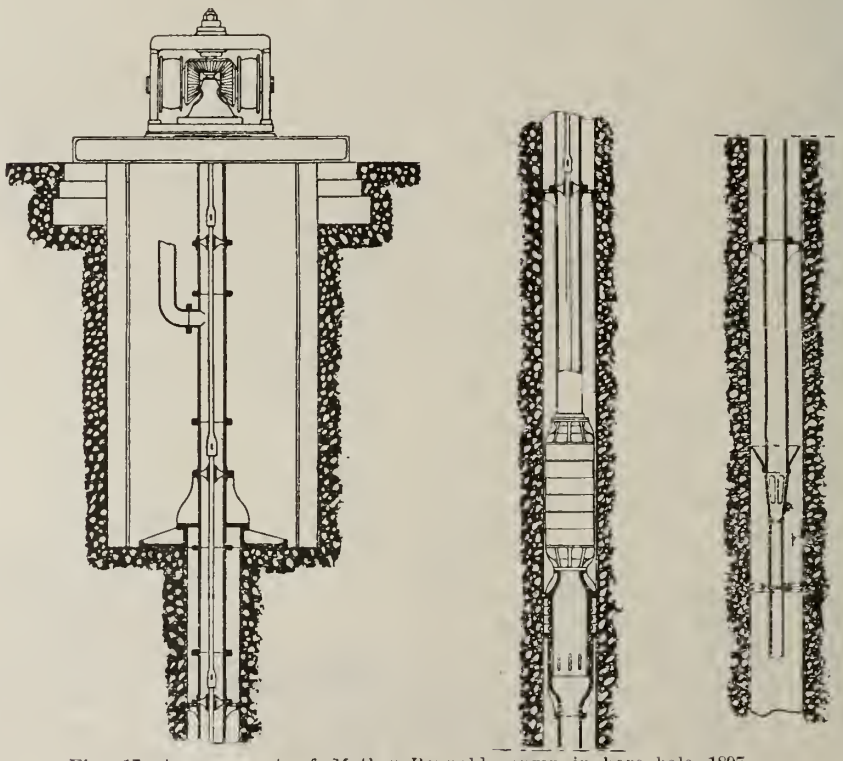


Fig. 17—Arrangement of Mather-Reynolds pump in bore hole, 1897.

Mine Pumps: Sulzer Installation of 1898

The authors believe this to be the first installation of centrifugal turbine-pumps of large capacity for mine drainage. It

consisted of three multiple pumps arranged in stages, the pump of each stage delivering direct through the rising main to the stage above. The pumps were motor-driven and each set was erected in a chamber off-set from the mine-shaft measuring 26 feet by 11 feet 6 inches by 11 feet 6 inches, thus demonstrating the great convenience afforded by this type of pump for underground work. The capacity of the installation was 1,000 gallons per minute against a total head of 1,500 feet.

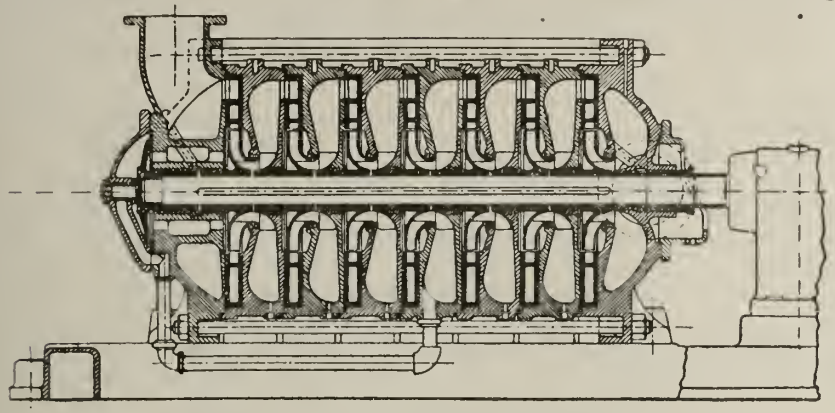


Fig. 18—Mine drainage pump, 1911. Mather & Platt.

Engineering Laboratory Plant, 1900.

This plant, constructed for the engineering laboratory of the University of Cambridge, consisted of a pump at one end, a similar turbine at the other end, and an electric motor between them. It forms an interesting combination designed for the purpose of carrying out a variety of tests. It could be worked either as a motor-driven pump, or a turbine-driven dynamo or as a combination, the motor making up the loss of power in the water passing the turbine and pump, thus giving a hydraulic Hopkinson test. For this last purpose the magnets of the motor were slung on ball-bearings and provided with arrangements for measuring the torque.

Newcastle Electric Power Station, 1901.

The combination above described was made use of later for actual installations, amongst others at the Newcastle electric power station for circulating the condensing water. The pump raised and forced water from the river to the condenser in the electric generating station in the town, the return flow to the river passing through and driving the turbine, the loss being made up by the electric motor in between.

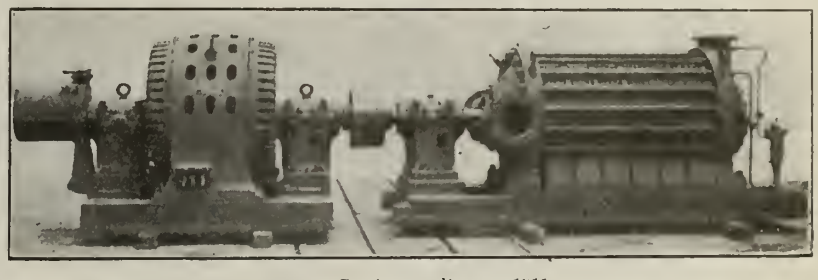


Fig. 19—Mine Drainage Pump, 1911.

Mine-drainage Pump, 1911.

Figs. 18 and 19, show a section through a series turbine-pump lately constructed for mine drainage. It is interesting, as it is probably the mine pump with the largest capacity yet constructed. This pump is capable of delivering 2,500 gallons per minute to a height of 2,000 feet when running at a speed of 1,450 revolutions per minute, and absorbs over 1,900 h.p. at the spindle. It is operated by a three-phase motor of 2,500 volts, direct coupled through a flexible coupling of the pin and rubber-bush type.

The pump has seven impellers arranged in series, working in chambers, following each other in the same manner as those pumps already described, and not as is sometimes done for such high heads by arranging the impellers back to back, with the intention thus to balance the end pressure. The series impellers are constructed of phosphor-bronze, and are mounted on a shaft of extra large diameter, to prevent sag in the middle and allow of fine clearance in the neck rings at the eyes of the impellers, thus reducing leakage. The guide-vanes into which the impellers discharge are large castings of special bronze, double-sided and cast in one piece, thus securing increased rigidity.

The intermediate chambers have the return passages from the periphery to the suction of the next impeller east in.

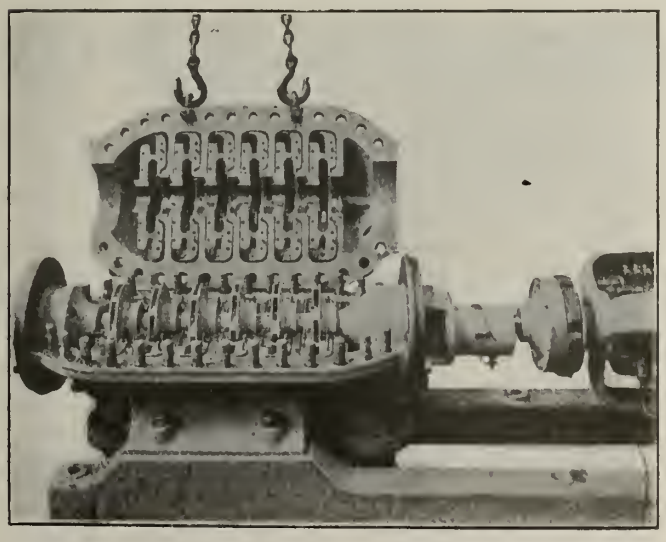


Fig. 21—Electrically driven boiler feed pump, 1909, capacity 140 gallons per minute. Delivery pressure 260 lbs. per square inch at 1,270 R.P.M.

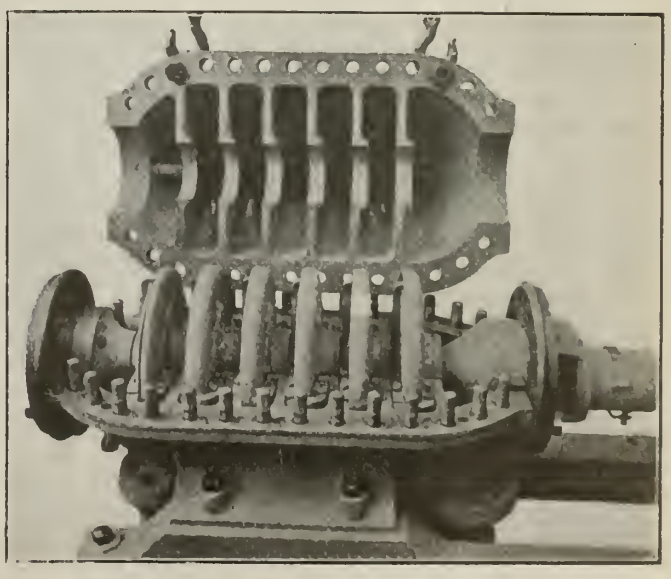


Fig. 21—Electrically driven boiler feed pump, 1909, capacity 140 gallons per minute. Delivery pressure 260 lbs. per square inch at 1,270 R.M.P.

They are of cast-iron, and have feet cast on, which, resting on the planed surface of the bedplate, support and keep the whole pump in true alignment, a precaution more necessary when the length of the pump is as great as in this case. The construction also facilitates the stripping and rebuilding of large pumps. There is only one exterior bearing, in the form of a separate pedestal standing on and bolted to the main bedplate at the suction end. The reason for this bearing being separate and of such a solid form and not overhung from the pump-casing, as in the more standard form of smaller pumps, is due to the large power transmitted through the pump shaft at a high speed. There is a water-logging passage to the shaft at the suction stuffing-box to prevent air leakage.

At the delivery end of the pump there is an internal automatically grease-lubricated bearing and a differential end balance-plate readily accessible for examination and adjustment, a great advantage with dirty waters. This construction obviates the disadvantages of a gland at the delivery end, subject to the full head pressure, with its attendant leakage and cutting of shaft. The lubrication of the internal bearings is effected by a piston worked by the head pressure pumped against.

Boiler Feed Pump, 1909.

Figs. 20 and 21 show an electrically-driven boiler feed-pump, consisting of two six-chamber pumps in series, of the split-body type, allowing of the whole of the inside impellers, shaft and guides being taken out together when the top half-cover is removed. This is a much simplier and quicker operation than taking adrift a standard type, but it is a more expensive form of construction.

The difficulty in such a design is to deal with the 260-lb. per square inch internal water-pressure on the split joint. Reference to the illustration will show how this is accomplished. It will be seen that the impellers are surrounded by guide-plates, put on in halves and bolted together, and the whole is then placed in a casing divided in the middle horizontal plane. The casing is provided with as many dividing ribs as there are impellers. Turned bosses on the guide-discs rest in suitably machined seats in the dividing ribs. The top cover is bolted on to secure them in their places, and they are prevented from rotating by pins. The main joint against heavy pressures is thus a plain one and of great rigidity, and can easily be maintained tight. The capacity of the pumps shown is 140 gallons per minute, 260-lb. per square inch delivery pressure at 1,270 revolutions per minute.

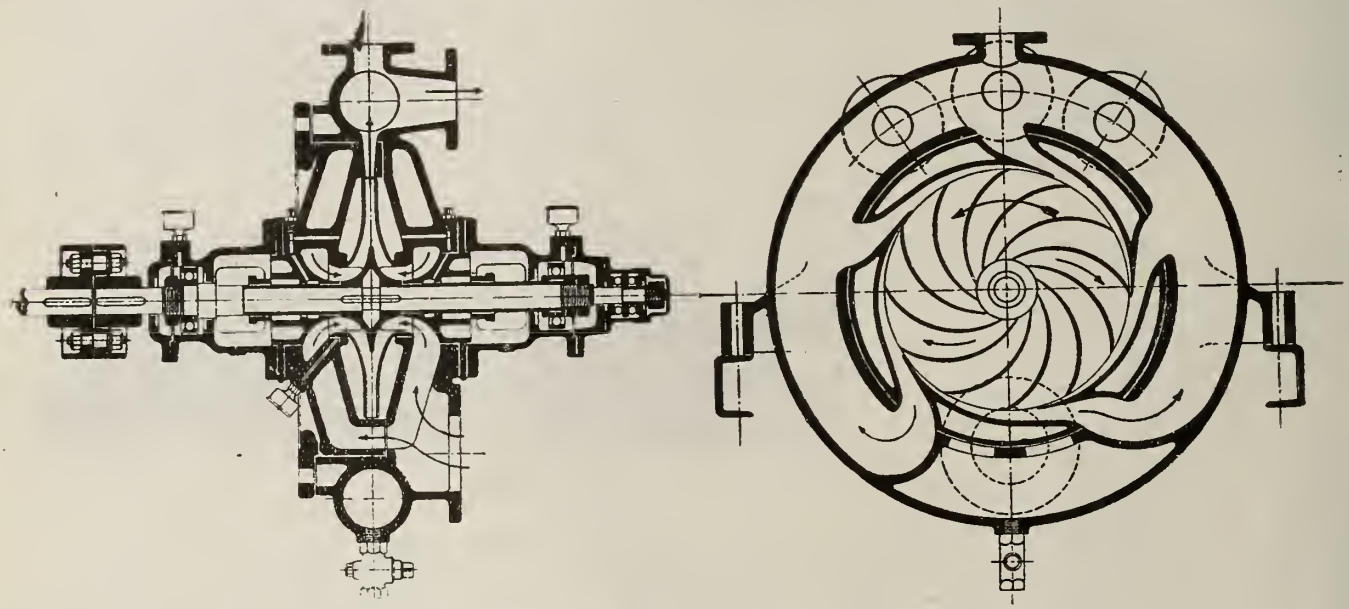


Fig. 22—Single chamber, high lift turbine pump. (Mather & Platt).

Fire Pumps.

An interesting application of the turbine-pump for fire-prevention purposes, as fitted to petrol automobile fire engines, is shown in Fig. 22. The capacity varies usually from 350 to 1,000 gallons per minute, against a head of 250 to 300 feet. The pump has a single chamber and is designed to fit on the back part of the chassis of an automobile, and to be driven by an extended shaft from the engine. The regularity of the flow of water delivered renders the holding of the hose-jets much easier and the action of the turbine-pump allows the shutting off of any particular jet, or of all the jets, without any tendency to burst the hose-pipes, as may be the case with a reciprocating pump. Further, the pump is much lighter than a corresponding pump of reciprocating type, and takes up considerably less space. The difficulties incident to starting with a heavy suction can be met by the provision of a small auxiliary pump which exhausts the suction pipe, thus causing the water to fill the turbine-pump. As soon as the turbine-pump has developed its head pressure, the auxiliary pump can be put out of action, and the turbine-pump will continue to work with suction lifts up to at least 80 per cent. of the height of the barometric water column.

Waterworks Pump Driven Direct by a Steam Turbine, 1908.

This pump, like the mine-drainage pump, already described, is of very large capacity, but differs from it in running at a high speed, being driven direct by a steam-turbine. The plant is installed at the St. Gabriel pumping station of the Montreal Water and Power Co., situated on the banks of the St. Lawrence, and is capable of delivering in continuous work 10,500 gallons per minute at a head of 404 feet. The turbine is of the Zoelly type, 1,350 to 1,500 revolutions per minute, and is capable of normally developing 1,720 b.h.p. with steam at 165-lb. per square inch and 150 degs. F. superheat. The air-pump of the condenser is independently driven through reduction gear by an enclosed high-speed reciprocating engine placed at a lower level than the steam-turbine pump. This auxiliary engine is of about 275 h.p. and runs at 465 revolutions per minute. Direct coupled to the other end of the shaft is an auxiliary low-lift pump which draws water from the suction-well and delivers it to the main pump at a small pressure, thus relieving the main pump from suction, and thereby effectively preventing any trouble in that pump from cavitation. A portion of the water from the auxiliary pump is by-passed through the condenser

on its way to the main pump. It thus serves also as a circulating pump. The main pump is of special design in that, owing to the high speed, only one impeller is needed to give the head and two are required for the quantity. Consequently the pump is of two-chambered parallel type. Each of the impellers has a double entrance, so that the shaft is in lateral equilibrium and no balancing device is required. A plant of this character has great advantage over a direct-acting or gear-driven reciprocating-pump in the relative smallness of the space occupied and foundations required and in silency of operation. The steam-turbine and pump are illustrated by Fig. 23. This pump and the mine-drainage pump, already described, so far as the authors are aware, are the largest of their type in the world, and so give a fitting indication of the development of the Reynolds turbine-pump since its inception thirty-seven years ago, and illustrate some of its great possibilities in various duties.

CORROSION OF CONDENSER TUBES.

By Arnold Philip.

ALL condenser tubes, he said, through or round which sea water flowed, were corroded, but the nature of the corrosion varied very greatly. By far the greater number of such tubes were merely uniformly corroded over as much of their surface as was exposed to salt water, but a certain small number of tubes, besides the uniform corrosion of their surface on the sea-water side, also underwent a local corrosion or pitting, which caused trouble to the engineer. The author's remarks applied specially to the relatively small number of cases in which localized corrosion occurred in condenser tubes made of Admiralty composition—namely, copper 70 parts, tin 1 part, and zinc 29 parts. It was his opinion that the cause for fully 90 per cent. of the cases of corrosion observed in the establishments of the Royal Navy had long been known; the methods of overcoming or neutralizing such corrosive action had been the subject for experiment, and very effective protective devices had been employed for a long time. It was conceivable, however, that more satisfactory preventive methods might be devised in the future, and doubtless it was to this end that the investigations of the Corrosion Committee would be largely directed. The 10 per cent. of the total cases of observed corrosion was considered to be rather an excessive estimate of the number which were found to be obscure in origin. There were several reasons for this opinion, and among them was the difficulty of obtaining full and trustworthy information concerning the natural history of the occurrence. The necessarily high pressure under which engineering duties were normally carried out rendered it difficult and sometimes impossible to state fully all the observable conditions under which a particular case of corrosion had occurred, and the omission of such details, it was considered, frequently caused such an instance of corrosion to be classed as one of the 10 per cent. of obscure cases, whereas it should actually be classed amongst those of which the origin was known.

Freedom From Corrosion in the Navy.

One of the chief difficulties in studying the behavior of condenser tubes under corrosion was due to the fact that the corrosion so seldom appeared. In spite of the fact that some millions of tubes were in use in the Royal Navy at any given moment, the number of cases as coming under the notice of the author, in which localized corrosion had been observed, did not at present amount to more than about two yearly. This freedom must, it was considered, be attributed to three causes:—First, to the particular chemical composition of the metal which had been selected for the manufacture of tubes. Secondly, to the very satisfactory manner in which tube manufacturers were able to produce tubes of the exact chemical composition specified; and in this connection it might be stated that during the past ten years only one case was known to the author in which the chemical composition of a corroded tube could be considered as not satisfying the specified limits. In that particular case the 1 per cent. of tin had been omitted from the mixture. The third cause to which the freedom from corrosion of the condenser tubes used in the Navy was to be attributed was undoubtedly the consistent manner in which the use of steel, iron, or zinc protector slabs and bars had always been insisted upon. The protective action of iron and zinc in condensers in the service had been utilized in several forms. It was originally used in condensers in which the body was of cast or wrought iron, and the sea water passed outside the tubes, and was, therefore, at the same time in direct contact with the outside of the metal condenser tubes and the inside of the iron case. In these circumstances the protection was complete, and whilst corrosion of the steel or iron casing took place, the corrosion of the tubes was practically unknown.

The presence of a so-called electro-positive protective metal such as aluminum, zinc, or iron alone, however, was not sufficient to prevent the corrosion of the condenser tubes immersed in the same bath of sea water, and it was essential that there should be a direct electrically conducting connection between the tubes and the protecting metal or metals, and that the protector metal and the condenser tubes should be both immersed in the same electrolyte. It had been shown again and again that any want of a good electrical connection rendered the protective action of the iron, steel, or zinc upon the condenser tubes quite nugatory. Where, however, the contacts of the protective metal with the tubes were satisfactory, corrosion did not occur.

A peculiarity of the small number of the cases in which corroded condenser tubes had been observed was the fact that in almost all them, the corrosion had occurred along the bottom of the

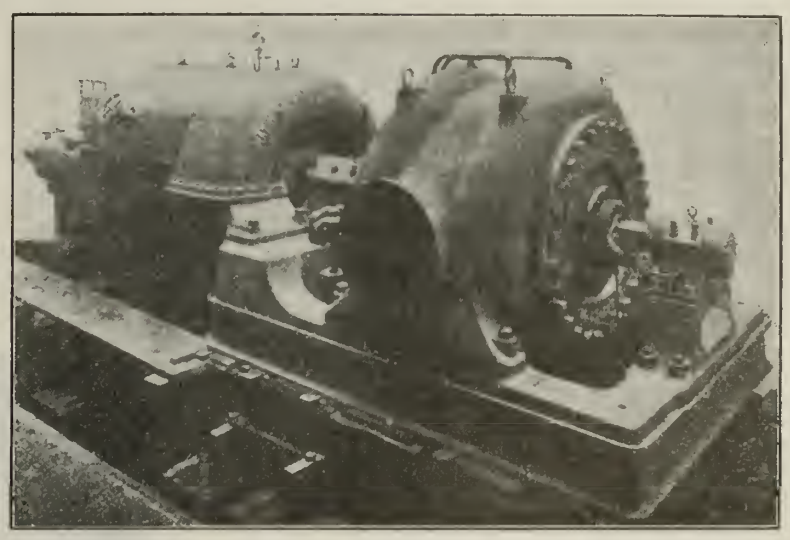


Fig. 23—Waterworks pump driven by steam turbine, 1908, at the St. Gabriel Pumping Station of the Montreal Water and Power Co., Montreal, P. Q.

inside of the tubes, and it was considered that this indicated that the trouble had been set up by the contact of particles of coke, carbon, or ferric oxide, or materials deposited from the cooling water upon the inside bottom surfaces of the tubes setting up local galvanic action. Such action was increased, of course, when a condenser was not in use and the tubes remained full of sea water, for the particles then had time to settle out along the bottom line and gave rise to the localized corrosion. If, on the other hand, the condenser was emptied of sea water when out of use, there would again appear to be a possible source of danger of corrosion along the bottom inside surface of the tubes, owing to the fact that this portion would be longest exposed to the joint action of salt water and air. In either method of treatment, however, it was considered that the causes of corrosion could be minimized or altogether removed if it were found to be at all feasible to employ condensers with vertical or strongly inclined tubes, and if every precaution were observed to take up the cooling water from such positions as would give the least chance of ashes from the ash-ejector being carried into the tubes.

The author then gave particulars of five cases of corrosion of condenser tubes which were all that had come under his observation during the past three years, and in only one of these was it impossible to ascribe the corrosion to the contact of particles of electro-negative solid conducting material. In this case it was considered evident that the corrosion had been due to the faulty connection between the tubes and the zinc protectors which had been acted upon very little.—T.E.S.

WHERE SUPERHEATING WOULD NOT PAY.

THAT the cost of superheated steam may easily be greater than the gain in efficiency from its use is shown in a recent investigation made by Arthur D. Little, Inc., of Boston. The question at issue was, whether it was worth while to add 75 degrees of superheat at the boilers of a plant which consisted of six 400 h.p. Babcock & Wilcox boilers located in a central house, and supplying steam to centres of distribution by pipe lines respectively about 120, 350, and 600 feet in length. The pipe lines from these centres to the various engines and heating systems had been used for several years, and it was desirable on grounds of expense to continue to use them if such use did not interfere with the economy of power.

It appeared that the greater expension and contraction of the pipe lines which would be caused by superheated steam would give the piping a greater strain than had been previously put on it, and would mean a good deal of overhauling of valves and joints. Calculations showed that the proposed 75 degrees of superheat, moreover, would ultimately add very little to the efficiency of the engines in the different mills, because of the losses due to transmission through the long pipe lines. Greater superheating, again, would demand practically a complete new system of piping, and was discarded largely on that account.

The course finally recommended was to omit the superheaters at the boilers, to design the new pipe lines with allowance for considerable loss of pressure at the greatest loads, to increase the boiler pressure enough to overcome the friction in these pipe lines, to set up in each mill a large receiving tank and separator, well insulated, and as near as possible to the engine. It was held that this arrangement would deliver the steam comparatively dry, at about pressure that had been customary before, and that the slight loss in efficiency would be offset by the lesser cost of the smaller pipe system and the corresponding reduction in radiating surface.

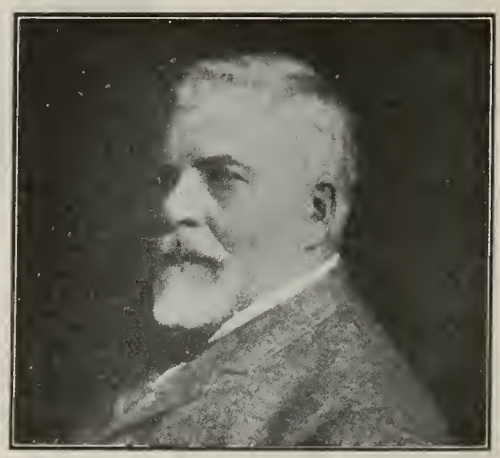
THE LATE RICHARD CRANE, AND COLLEGE TRAINING.

By J. H. W.

IN the death of Richard Crane, which occurred recently, the advocates of a thoroughly practical training for those entering the engineering profession have lost a strong supporter. Mr. Crane was the founder and president of the well-known Crane Co., Chicago, whose valves and fittings are familiar to every operating engineer. Born in Paterson, N.J., on May 15, 1832, he left school at the age of seven, and when 15 got his first job in a brass foundry. In 1855 he opened a small brass shop in Chicago, thus laying the foundation for the enormous business now bearing his name.

As was perhaps only natural in a man of his early training, he looked at the question of the education of young engineers chiefly from a utilitarian point of view. The subject was one in which he took a deep interest, and on which he was never backward in stating his views. Always on the look-out for young men who might be useful to him in his work, he used to say "that the American colleges and technical schools are not turning out such men to-day, though they never tire of asserting that the training they give is the one pathway to success, and that there is a constant demand by manufacturers for college graduates." Mr. Crane investigated this latter claim and found it greatly exaggerated. Few really want the college product, it having so often proved unsatisfactory. In fact the supply so greatly exceeds the demand that the pay of those who do succeed in obtaining positions is generally very small.

Mr. Crane, in order to prove the weakness of their claims, wrote to thirteen of the principal universities and technical schools in the States, requesting prominent firms who were desirous of prominent firms who were dcsirious of employing their students. Various excuses for withholding the desired information were given by eight of the schools addressed, while the other five sent in lists totalling eighty-eight firms. On analysis of these it was found that such demand as there was, came chiefly from the railroads and the big electrical and telephone companies. The railway demand is never really brisk, and one at least of the large electrical concerns—the General Electric—is said to be considering the abandonment of their present scheme and the initiation of a new system involving shop, instead of college training. The deceased gentleman was a firm believer in getting boys into the shop at 16 or 17 years of age, and claimed that in this way they learnt nine-tenths of the theory needed, and could easily pick up the remaining tenth at evening classes or at college subsequently.



THE LATE RICHARD CRANE

He was an enthusiastic advocate of manual training schools and spent over $200,000 annually in founding and developing such institutions in Chicago. He, however, never had any use for the college-trained engineer whose "practical experience" consisted of a few vacations spent in a machine shop or drawing office.

Mr. Crane was one of the best known manufacturers in America, and also enjoyed considerable prominence as a speaker and writer on social and educational matters. One of his last publications was an address to college students entitled, "The Futility of Technical Schools," in which he began by saying that no one "can afford to throw away eight of the most important years of his life in acquiring a schooling that will be of little or no use to him," and goes on to claim that the boy who starts in the workshop or factory has a powerful advantage over the college student, which the latter will never make up. Most manufacturers are agreed as to the validity of most of Mr. Crane's arguments; thought it must be remembered that he was a purely utilitarian engineer and was not interested in pure mathematics or the higher flights of science; though in common with other manufacturers he benefited by them. There is always a call for highly trained minds to carry on the world's work in the sphere of scientific investigation and discovery, but at present the universities seem to be turning out youths only "half-fledged."

In 1900 the Crane Co. inaugurated a profit-sharing scheme amongst their employes, on the basis of 10 per cent. of the annual earnings of each man. In this way over $3,000,000 has been distributed to date.

TURBINE PLANT REDUCES POWER COST IN TEXTILE MILLS

THE efforts of engineers to design power plants which will materially reduce power cost for industries using a great amount of power are meeting with considerable success, and when the cost per k.w. hour begins to compare favorably with central station costs it indicates that great strides have been made toward solving the power problem. The following interesting data from the weekly records kept at the turbine power plant of the Pacific Mills is a specific example of what is being done. The Pacific Mills represent several large industries at Lawrence, Mass., and employ about 9,000 operatives. The new turbo-power plant, which was designed by Charles T. Main, mill architect and engineer, of Boston, to meet an increased demand for power, consists of a boiler and turbine house, and a separate coal pocket. There are six batteries of four boilers each, the boilers being of the horizontal return tubular type, 72 in. by 21 ft. 6 in. The turbine equipment consists of two Allis-Chalmers 750 k.w. turbo-generator sets, and two 3250 k.w. sets of the same type.

Operating Cost Figures.

The following figures are for cost of operating an average week on 3600 k.w. The plant has been operated under these conditions for the last year.

Turbine room labor, 5 men and superintendence	$ 99.85
Boiler room labor, 8 men and superintendence	99.15
Fuel at $4.25 per long ton in pocket	880.00
Oil, waste and supplies and repairs	37.05
Total operating expense per week	$1116.05

During the week 204,780 k.w. hrs. are generated, giving a cost per k.w. hour of .545 cents. At this time the normal operating condition will be to run the two large turbines, leaving the two smaller ones as spares.

To operate the station under these conditions will cost:

Turbine room labor, 5 men and superintendence	$ 99.85
Boiler room labor, 9 men and superintendence	108.95
Fuel, at $4.25 per long ton in pocket	1483.25
Repairs and supplies	58.60
Total opg. cost per week	$1750.65

Operating cost per k.w. hour = $\frac{\$1750.65}{340{,}000} = .515$ cents.

The station as it now stands with 8000 k.w. normal capacity of generators, cost, with land and everything up to and including the switchboard, a little less than $90 per k.w. Figuring the fixed charges on this at 11%, we get:

$11\% \times 720{,}000 = \$79{,}200$ per year.

Or $\$79{,}000 \div 52 = \$1{,}523.08$ per week.

With station generating 340,000 k.w. hrs. per week, the fixed charges will be

$\frac{1523.08}{340{,}000} = .448$ cts. per k.w. hr.

The total cost then, per k.w. hr. at the switchboard, for the 6100 k.w. load on the plant, will be:

Operating expenses per k.w. hr.	0.515c
Fixed charges per k.w. hr.	0.448c
Total	.963c

The same figures, if this plant should be operated at its full capacity of 8,000 k.w., as is quite customary in textile mills, would be:

Opg. charges per k.w. hr.	0.501c
Fixed charges per k.w. hr.	0.448c
Total cost	0.841c

It will be seen from these figures that the cost of power production compares very favorably with that in great central stations, and is also a considerable saving over the old system consisting of many small units scattered throughout the mills.

FROM RECIPROCATING ENGINES TO SMALL TURBINES.

By G. T. R.

THE advance of the small steam turbine has been remarkable. There seems to be no limit to the variety of uses to which it can be put. Statistics carefully compiled by one of the leading small turbine companies show that steam turbines are driving centrifugal pumps in over 55 different kinds of service, while they are extensively used for driving generator sets, force draft blowers, gas blowers, cupola blowers, etc. Transitions due to the small steam turbine are daily seen and one plant which is rather interesting, consisted three years ago of two 200 k.w. Corliss engines direct-connected to generators. To this plant was added a 150 k.w. Terry turbine-driven generator outfit. The results were so satisfactory that in 1910 one of the 200 k.w. Corliss engines made way for a 200 k.w. turbine-driven generator set of the same make, and now the other Corliss engine is being replaced by a similar steam turbine set of 300 k.w. This means that at this plant in three years a complete change from reciprocating engines to small turbines will have been made.

LARGE DIESEL OIL ENGINES.

IT is not generally known that Messrs. Krupp, of Essen, Germany, have been engaged for some considerable time past on the development of the double-acting Diesel engine, particularly for marine work. They were one of the first firms to take up the construction of these engines, and have manufactured a very large number of two-cycle motors up to 1,000 h.p. working on the single-acting principle, most of which have been supplied to the Russian Government. Some time ago they built a single-cylinder double-acting two-cycle engine, and this has now been running successfully in the shops without giving any trouble, either with the glands or with the bottom cover, which has been the cause of some of the difficulties experienced with double-acting engines. It is worthy of note that up to the present there seems to have been no confirmation of the generally expressed view that double-acting Diesel engines would involve trouble with the glands, but the matter cannot of course be considered as settled until further experience has been obtained.

Correspondence

THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

By Generator.

IN the January issue of The Power House, under the head of correspondence, there appears a letter from the pen of W. Norris, executive president the C. A. S. E., criticizing the letter of Generator, which appeared in the December issue. The executive president has evidently gone to considerable pains in the writing of his letter, as is evident in his attempt to reply to Generator in electrical terms. We are also amused —amused, yes, that's the word. The president is afraid that Generator has an open circuit. Such is not the case. We have delivered the necessary amount of juice to the switchboard, as have also several other generators. I am sorry to say that said juice has laid dormant there, and when attempt has been made to utilize it, we have found our lines short-circuited, and all our fuses blown out.

Now, for a little more data. This particular make of machine is a member in good standing, and his object in writing that December letter was because he considered it in the best interest of the association. He still considers that it is in the interest of the C. A. S. E. to attack the executive officers when they neglect to do their duty. Bro. Norris is quite conversant with the inside workings of the association during these last three years, and when I make the statement that the association's interests were not only neglected, but in some instances sacrificed, he will, if he be fair, acknowledge it. Be it understood that I can verify my statements, but sincerely hope that it will not be necessary, as it is not my wish to give to the public anything that will be detrimental to the C. A. S. E.

Bro. Norris has made another serious mistake. He implys that Generator has (if a member of the association) not tried to accomplish anything himself, but has left it all for the executive to do. Now, I am a little bit modest, but would just like to say that I have taken a very active part in the affairs of the C. A. S. E.; I have sacrificed money and time to uphold its prestige, and have been instrumental in securing an average of at least five new members per year during the last few years. Further, I am still willing to put my shoulder to the wheel and push a little bit harder than the other fellow, if necessary. I, again, have to make the statement that our officers have been inactive (and if I don't know any better), I have been in a position to know possibly more than Bro. Norris, of what took place between the 1910 and the 1911 conventions, when the subordinate lodges were left to themselves to make their appeal to the powers that be. The consequence was that nothing was accomplished in regard to legislation or advancement to the profession.

It is hard to believe that all has been accomplished that possibly could be when we stop and consider. Here is the C. A. S. E., incorporated for nearly 25 years, with a membership of about 500 engineers, scattered in different centres throughout the Province of Ontario. The Government statistics show that there has been issued over 8,000 certificates to engineers throughout the province. Why, at the present rate of progress it will require about 375 years before the C. A. S. E. has enrolled them as members. Is this progress? Not the kind that Generator desires to see anyway, and I am convinced there are a whole lot of other Generators running parallel with me on this question. Why is it, if the association is accomplishing all that it should, that the membership in one of the strongest subordinate lodges decreased 50 per cent. during a recent year?

Now, Generator is not to be classed as a sorehead or a disgruntled office seeker, as I have never been an aspirant for an official position on the C. A. S. E. executive board, but I have been a keen observer of the doings at the annual conventions for a few years, and have viewed with disdain the loss of valuable time in the discussions of petty affairs, while those of real value to the operating engineers are left untouched. I am pleased to see that Owen Sound Lodge, No. 25, has approved of the sentiments as set forth in my December letter, and I also know that large numbers of individual members have endorsed my statements. In conclusion, Bro. Norris, you know that a hammer is a mighty handy tool around a power house, and that it is sometimes necessary for said hammer to get busy and do a little knocking in order to prevent everything going to the bow-wows. Believe me, that object is going to be attained, as is evident in the aggressive movement that has already taken place, and if it constitutes honor and a true and lawful brother to abstain from criticism of my executive officers when I am firmly convinced that they are inactive and neglecting the association's affairs, why, I will have to plead not guilty on all charges. However, I will still reserve the right to consider it more honorable to criticize, and through criticism advance the interests of the stationary engineers than to keep quiet and let things move along in the same old rut.

Port Arthur, No 29, C.A.S.E., held its regular meeting on January 16th, and three applications were received for membership. We are sending a petition to the government re graded certificates, and asking at the same time that the horse power rating and working steam pressure be reduced to 10 h.p. and 5 lbs. respectively, so as to make it compulsory for hoisting engine operators, etc., to carry a license. Further, we are petitioning in favor of securing a government inspector for all boilers in the district. We are hoping for much helpful legislation from the new parliament this session, and as we had not heard what line of action the executive of the C.A.S.E. was taking, we determined to get things moving ourselves. We have become affiliated with the Trades and Labor Council of Port Arthur, and being so far away from the headquarters of the C.A.S.E. are, together with the former, trying to secure the influence of the Board of Trade in order to bring pressure to bear on the government to in some effective way, improve the status of the man at the throttle.—Fred Nagle.

Owen Sound, No. 34, C.A.S.E.—The lodge meetings during the past month have been especially attractive and well attended, much study being given to the interests of the younger members. Bro. John Snowball prepared and read a paper entitled "The Economical Combustion of Fuels," at a more recent session and much valuable information was made available on this important subject. One new member has been added since our last report. The correspondence columns of "The Power House" are being closely followed.—W. J. Needham.

Admitting Steam to the Pipes and Engines.—All drain cocks should be fully opened before steam is admitted to pipes, cylinders, etc. Stop valves should be opened very gradually and the pipes, etc., allowed to warm up and be cleared of all water before the full pressure of steam comes upon them. It is highly dangerous to open any stop-valve or drain-cock on a range of steam pipes which contain water, when steam is on them, as this may produce "water hammer," by which the pipes or valve chests are liable to be burst and an explosion produced. If a pipe, which is under steam, is believed to contain water, the boiler stop-valve should be closed, after which the drain cock may be opened and the water run out and steam again slowly admitted to the pipes. When steam is not required, it should be shut off and all drain cocks opened on the pipes or cylinders.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. V. FEBRUARY, 1912 No. 2

EFFICIENCY AND RELIABILITY OF EQUIPMENT.

AS a result of careful observation extending over a large number of power plant equipments installed in recent years and presently fitting out, we are in a position to state that all indications point in the direction of simplicity, efficiency and reliability. It is not so much a question of purchasing apparatus from a reputable firm that has contributed to the foregoing circumstance, but rather the high standard set by the great body of manufacturers individually.

The consumer, to-day, is anxious to secure the best class of machinery for his particular purposes, and is willing to pay if necessary, the higher first cost demanded. A strong co-operative movement is in evidence between the manufacturer and his customer, and nothing is more conducive to best results than such a circumstance. There is fast disappearing that spirit of distrust and suspicion, much of which was unreal and imaginary, and its hastening to complete extermination is the duty of all of us to accelerate. First cost, although needs be high, is not by any means the prime factor in the power plant equipment of any municipality, public utility corporation or manufacturing concern, and due consideration should always be given this feature. Some one has aptly said "that the problem to be faced is not one of saving power, but its more effective utilization for a definite purpose."

The same conclusion is equally forceful and applicable to the question of light and perhaps even more so, because nothing we believe contributes so effectively in hampering and restricting output of product as does the circumstance of poorly lighted workshops. The records of power plant performance appearing regularly in this journal, and covering every section of the field, should be carefully studied, as each one bears out and confirms what has been our own personal observation experience.

THE INDIVIDUAL ENGINEER'S DUTY.

DURING the past few months, correspondence relative to the effort or lack of same put forth by the executive of the Canadian Association of Stationary Engineers has been a feature of our columns. It is not our intention, for the present at any rate, to make a pronouncement on the subject; rather is it to seek to impress on the individual engineer—be he an association man or otherwise—the necessity of preserving and cultivating individuality in addition to his general furtherance of a communty of interest. We are prone to believe that more than its due amount of attention is given to the ventilation and encouragement of this latter feature, with the result that other and more vital personal interests are sacrificed. We can imagine that the letters of "Generator" and Mr. Norris have been prominent if not all-absorbing topics among the C.A.S.E. members in their lodge rooms, and that much other spare time of the individual has also been so occupied. Most of us, too readily and also too fully embrace, jump into and take sides in any contest that mayhap arise, and having done so, find it hard, as it were, to come back to normal again.

The individual operator should not forget that on him alone rests not only personal success, but that also of his Association. A match box is a most useful and invaluable part of the equipment of most men—even non-smokers—when well filled with live lucifers, but the empty box, as the only feature when the torch comes to be lit, means uselessness. Societies, Institutions, Associations, etc., are much in the nature of glorified match boxes; they are only valuable to the extent that their membership consists of numerous individuals with live heads. A well filled box, however, gets a fire occasionally, through one or more heads rubbing a trifle harshly against each other, and the outcome is, as a rule, not over satisfactory. In addition to a sulphurous atmosphere prevailing, the box or casket suffers also to some extent. It is possible to have a similar eventuality occur in the experience of our glorified match boxes—the societies, institutions and associations—and members of all or either must guard against and take every precaution to avoid a flare-up.

It is the individual's duty to carefully weigh both the inside and outside point of view of all questions and analyze them, for either may be wholly or partly right, or wholly or partly wrong. To exercise this function, which is at once a duty and a privilege, and to give to it all the attention it deserves, a man should be a master craftsman and a diplomat. To be a master craftsman requires patience and persistent application to the task of both making and keeping oneself fully alive to the rapidly developing mechanical age in which we live. It should further be realized that practically 100 per cent. of attainment is due to ourselves. Our societies, institutions, associations, etc., are more or less fraternal and should not be looked upon as a species of offensive, defensive and all powerful "Dreadnought" and "achieve-all."

GAS AND OIL ENGINE PROGRESS

A record of principles of design, construction and achievement in a rapidly developing sphere of power generation.

THE DIESEL OIL ENGINE.

THE following is an abstract of a paper read at the recent meeting of the British Association by Charles Day, Managing Director of Mirrlees, Bickerton & Day, Ltd., Hazel Grove, Stockport—makers of the Mirrlees-Diesel engines :—He said that the economical generation of power for industrial purposes depends mainly upon the following factors :—1. (a) The attainable economy of working at different loads of the prime mover itself, including boiler or gas producer, and all accessories, such as condensers, feed pumps, water pumps, etc. (b) The degree to which this attainable economy can be practically maintained under the conditions of working, and the load factor. 2. The stand-by losses, i.e., the expenditure necessary to keep the plant ready for work when wanted. 3. Wages of engine-room attendants, stokers, and other men employed about the power house. 4. Expenditure on lubricating oil, cleaning, waste, and sundry stores. 5. Cost of repairs and of the maintenance of all parts of the plant in good working condition. 6. The cost of water for condensing, and for boiler feeding in the case of steam plant, for the engine water jackets, and for the gas producer in the case of gas plant, or for the engine water jackets in the case of Diesel plants.

Actual Service Results Only Reliable.

From the mere enumeration of these items, it is very obvious that tests either on makers' works, or on site, even though the tests extend for a week or so, do not form a sufficient guide as to the real value of the engines for industrial purposes, and that a far safer, in fact, the only safe conclusion, can be formed from a study of results obtained in actual practice. For instance, it matters not how economical an engine may be in regard to fuel if the expenditure in other directions more than outbalances the gain in fuel consumption. In actual service it is not to be expected that a power plant can always be kept and worked at its highest efficiency. The average results actually obtained over a term of years differ considerably from those attainable under the very best of conditions.

The great difficulty most buyers find is in securing reliable figures of power costs from people engaged in trade, except in the case of electric supply stations. The writer does not know of any body of large power users who systematically prepare accounts showing their power costs on a uniform basis and publish them. This practice in connection with electric supply stations fortunately does give an independent and authoritative basis from which valuable deductions can be made, and this, combined with information obtained direct from station engineers, has enabled the author to determine the average results obtained in such stations. With different types of plant these averages, for stations having a plant capacity not exceeding 1000 h.p., are as follows :—

TABLE I.—Average Cost per B.T.U. Sold.

Type of engine.	Fuel.	Lubricating oil, waste stores, and water.	Wages.	Repairs and maintenance.	Total works cost.	Load factor.
Steam..	.45d	.06d	.25d	.26d	1.02d	14.7
Gas....	.43d	.09d	.28d	.24d	1.04d	15.3
Diesel..	.23d	.04d	.19d	.07d	.53d	14.3

The limit of 1000 k.w. was fixed owing to there being as yet no large electricity supply stations equipped solely with Diesel engines or gas engines. Of course, better results are obtained when driving machinery which gives a better load factor, but the causes which produce loss are as a rule, the same, though modified in extent. The general conclusion formed from a study of electricity stations holds good for the great majority of power users, though, perhaps, not applicable to some special trades, where engines can be run continuously on almost uniform loads. It is also necessary to point out that the figures include some items which should not strictly be charged against the power plant. For instance, the wages items include figures for men working on cables, street lamps, and in sub-stations, whilst the repairs items include repairs to such parts. Also it is necessary to mention that the figures give the cost per unit sold and not per unit generated.

The Diesel Engine Records Most Favorable.

From the averages it is clear that a substantial gain is obtained by the adoption of Diesel engines, as against either gas or steam engines, the figures being beyond doubt substantially accurate. It is also noticeable that the gain is not only on fuel consumption, but is practically in the same proportion on the other items of expenditure.

The great saving shown by these average figures is confirmed by repeated experiences of the author. In many cases, although the figures guaranteed with Diesel engines have been no better than figures previously guaranteed, and obtained on tests, with existing steam and gas engines, the Diesel engines have shown over extended periods a saving of 50 and 60 per cent., and in some cases an even greater percentage, the result being due to the fact that the Diesel engine's average working results were very much nearer to the guaranteed figures than with gas or steam engines, combined with the fact that the relatively high cost of working at light loads with gas or steam had not been sufficiently taken into account when considering the guaranteed figures.

When going through cost records to prepare the average figures previously given, the author noticed very wide differences of cost per unit, particularly in the case of the steam plant. He, therefore, had the average cost calculated for steam stations of different capacity, and as the results are interesting, they are given separately in Table II. The table shows the great improvement which follows increase of size with steam stations, or expressed in the reverse direction it shows how great is the disadvantage of small stations when steam power is used.

Small Diesel Stations Highly Competitive.

It is further to be noted that even with the largest steam stations, the costs per unit generated are no better

than for quite small stations using Diesel engines, and this in face of the improved load factor. This is a most important point, and shows that small Diesel stations can profitably supply at prices hitherto thought to be obtainable only in densely-populated centres having large power stations. In all cases the figures which have been given are works cost, and do not include anything for interest on capital and depreciation. It is hardly possible to give a definite statement showing the cost of constructing and equipping power houses of different types, as there are so many variable factors. However, the author's experience of a considerable number of estimates indicates that up to a capacity of, say, 1000, k.w., there is generally little difference between the gross capital expenditure required, whether steam, gas, or Diesel engines be adopted.

TABLE II.—Average Works Cost per B.T.U. Sold on Steam Stations of Different Sizes.

Capacity of station not exceeding	Fuel.	Lubricating oil, waste, water and stores.	Wages.	Repairs and maintenance.	Total.	Load factor.
K.W.	d.	d.	d.	d.	d.	
250	.63	.09	.35	.36	1.43	13.2
500	.56	.06	.27	.29	1.18	13.3
750	.43	.05	.23	.24	.95	15.4
1,000	.40	.05	.23	.21	.89	16.8
1,500	.42	.04	.17	.18	.81	16.9
2,000	.37	.04	.16	.21	.78	17.7
3,000	.33	.04	.15	.17	.69	17.4
4,000	.40	.03	.14	.20	.77	18.8
5,000	.34	.03	.11	.16	.64	18.7
7,000	.36	.04	.13	.20	.73	17.9
10,000	.26	.03	.09	.13	.51	22.6
20,000	.30	.03	.11	.16	.60	19.6
50,000	.23	.02	.10	.11	.46	20.56

Engines for Dynamo Driving.

Having now dealt with what may be termed the commercial aspect, it may be well to study briefly the constructional features desirable in engines for dynamo driving. For speeds which are not slow, engines of the multi-crank type become desirable, otherwise serious vibration is likely to be caused. For the same reason it is important that the distance between the centre lines of the cylinders of an engine be reduced as much as possible, and on this account the vertical construction is much more suitable than the horizontal, and gives much better accessibility. The vertical design is also better from the point of view of piston wear.

Very complete enclosing, combined with forced lubrication, is in the author's opinion an absolute essential for high-speed engines, whether steam, gas, or oil. With the first few oil engines to which forced lubrication was applied, a portion of the lubricating oil got drawn up into the cylinders. Improvements in construction have, however, completely overcome this, and now the oil consumption is quite as low with the forced lubrication as with the ordinary systems. For moderate speeds of revolution, ring lubricating main bearings are thoroughly satisfactory, combined with centrifugal lubrication to crank pins. With such an arrangement less complete enclosing meets all requirements of cleanliness. There is another point in regard to the multi-cylinder design of engine which should be mentioned, viz., that with this design a smaller diameter of cylinder is required for a given power than with a single-cylinder engine. With internal-combustion engines this is of great importance, as, after a certain size, every enlargement of cylinder diameter brings with it increased constructional difficulties and a greater liability to breakdown.

Features of the Diesel Engine.

Turning now to the particular features of the Diesel engine itself, Carnot enunciated the conditions required for a perfect heat engine, and Diesel propounded a scheme which to a certain degree met the Carnot conditions. The original cycle has become modified to that now adopted, which may, therefore, be claimed to be the nearest to the Carnot cycle which present-day practical limits admit. The heat efficiency of the Diesel engine, though far from perfect, is still much better than that of any other heat engine, as is readily seen from the fuel consumption, which is 0.44 lb. of fuel oil per b.h.p. per hour. The fuel consumption is also low at partial loads, viz.:—¾ load, 0.45 lb.; ½ load, 0.47 lb.; and ¼ load, 0.62 lb. per b.h.p. hour.

These are not records, but every-day figures, and are for engines of quite moderate size. With larger engines the fuel consumption per h.p. is rather lower, but increase of size does not give anything like the improvement in fuel consumption that occurs with steam engines. This is a point to be remembered when fixing the size of engine to be adopted in a station. With steam plants the size of engine should be kept up, whilst with internal-combustion engines the size within certain limits can with advantage be kept down. Owing to the high economy at light loads it is often found distinctly advantageous to run a Diesel engine in preference to using a storage battery.

Nature and Grade of Oil.

The oil generally used is residual petroleum, i.e., the residue left from petroleum after the lighter oils have been distilled off. The increased demand for petrol will certainly tend to increase the further supply of residue, whilst the opening up of new oil wells in various parts of the world is steadily increasing the oil supplies. Not only is residual petroleum used for Diesel engines, but residue shale oil and gas-works tar oil are now much used. The fuel oil can be almost any of those in use for boiler firing, and a wide variety of oils can be employed with no alteration of the engine, this being probably explained by the fact that a pulveriser which will sufficiently pulverise a thick, viscous oil can easily pulverise the thinner oils. The use of oil fuel carries with it certain advantages in the way of ease of handling and of cleanliness. With coal it is difficult to avoid dust, and this is particularly objectionable in the case of steam plants. With oil there are no ashes to cart away, and thus handling of gritty materials is entirely eliminated. Usually the oil is pumped from an outside storage tank to the small tanks near the engines.

Long Periods Under Continuous Operation.

The question may naturally be asked whether Diesel engines are suitable for long periods of continuous running. In reply to this, the following instance may be quoted. At the Birkdale electricity works, a Mirrlees-Diesel was put down a little over four years ago. The station engineer recently made a return, which showed that the engine had on the average worked 23¾ hours out of every 24 hours throughout the four years, or an average stoppage of about 1½ hours each Sunday.

Numerous cases could be given of large savings effected, but the figures already given substantially prove this, and are, perhaps, more appropriate for a paper of this kind. It might be of interest to mention that the first Diesel engine made in Great Britain was a Mirrlees-Diesel engine, and was made over 14 years ago, consequently the present Mirrlees-Diesel engines represent quite a long experience; and the present appreciation of this engine is not a temporary boom, but is based on substantial experience.

EDISON ON ELECTRIC RAILWAYS.

Thomas A. Edison, the inventor, in Chicago, for the first time recently, since the World's Fair in 1893, told members of the Electric Club that the electrification of railroads would not be practicable for several years, and forecasted an announcement of a new type of electric motor he has invented. Third rails and trolleys, he said, would not be satisfactory as power transmitters for railways, and especially in switching yards. Improved motors and either generators, gasoline driven on board the power cars, or storage batteries, he thought, ultimately would be used.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

ELECTRICITY FOR ROLLING MILLS.*

By C. Antony Ablett.

IN introducing the subject, the author observed that the power required to drive a rolling mill generally varied rapidly between wide limits, while in order that power should be generated cheaply, the demand made on the generating plant should be maintained steadily at the full capacity of that plant. To ensure that the working costs of a rolling mill should be low, means must be found for reducing the fluctuations in the power required to drive the mill, care being taken in doing this, that the capital cost of the plant was not unduly increased, nor was the possible output reduced. Any reduction of the possible output was equivalent to an increase in the working cost, as the capital charges per ton were increased.

Variation of Power Feature.

The variations in power were reduced by employing a flywheel in conjunction with the electric motor used to drive the rolling mill, and by providing some device for reducing the speed of the motor and flywheel, so as to enable the flywheel to give out some of its stored energy when the demand for power was great, thus reducing the amount of power which had to be furnished by the motor. When the demand was small, the motor would speed up the flywheel, thereby replacing its stored energy; this increased the power which the motor had to supply when the demand made by the mill was small, and therefore reduced the total variation in power.

Apart from large reversing rolling mills, the largest variations in power occurred in tinplate and sheet mills. With merchant mills and bar mills, the variations in power were less, while in the ordinary looping mill for rolling wire rod, where the rod might be in six pairs of rolls at once, and where a fresh rod was entered while the previous one was still in the rolls, the power required to drive the mill did not vary much. A special case was that of a tire mill, where the variations in power were considerable, but where the power demand remained pretty steady for nearly a minute, so that a flywheel would not prove of much benefit in reducing the fluctuations in power unless it were very heavy indeed.

The stored energy of the flywheel varied as the square of the speed at which it was running, so that if a flywheel were used in conjunction with this motor it would only give up 4 per cent. of its stored energy as the power increased from light load to the full power of the motor. The rolling mill might require during a pass, a power equivalent to four times the normal full-load power of the motor for a few seconds; commercial motors would not give more than twice the normal full-load power for a few seconds without being liable to injury, and to prevent this, the circuit breaker was usually set to open at the current corresponding to that power. The flywheel, therefore, had to furnish the power which was in excess of that which the motor could give. In the case considered, the motor would fall perhaps 5 or 6 per cent. in speed when the power increased from light load to double full-load power, so that the flywheel would give up only 10 or 12 per cent. of its stored energy. The flywheel, therefore, would have to be abnormally heavy, or else if a flywheel of a weight within the bounds of commercial possibility were adopted, the combination would be unable to cope with this demand for power, and the motor power would increase until the circuit breaker opened. It was, therefore necessary artificially to increase the fall in speed of the motor as the power which it had to give increased. If the speed fell by, say, 10 per cent. as the power increased from zero to full load, and, say, by 22 per cent. as the power increased to the double full-load power, the flywheel would have given up 39 per cent. of the stored energy by the time that the motor was given double its normal full-load power, instead of from 10 to 12 per cent. A flywheel, therefore, of moderate weight, would materially assist the motor in overcoming heavy demands for power which lasted for a short time only.

In practice, the maximum power given by the motor would seldom be so much as double the normal power, nor would the motor power sink to zero, as even when nothing was being rolled, the motor would still have to provide the power for overcoming the friction of the mill, which was considerable. There were two devices for artificially increasing the fall in speed of the motor as the power demand increased. These were commonly spoken of as (1) the permanent-slip regulator; and (2) the automatic-slip regulator; but it would be more correct to call them (1) the continuous-slip regulator and (2) the intermittent slip-regulator.

The Continuous-slip Regulator.

In the case of the direct-current motor the continuous-slip regulator consisted of an ordinary compound winding provided for the field-poles, while the intermittent-slip regulator consisted of a system of relays which successively short-circuited resistances in series with the shunt field winding, thus increasing the field and causing the speed to fall when the power had reached a certain predetermined point. In the case of the three-phase motor, the continuous-slip regulator consisted of a resistance, liquid or metallic, permanently inserted in the rotor circuit, while the intermittent-slip regulator might be either a liquid resistance, the moving plates of which are controlled by a motor relay, so that the plates were raised and the rotor resistance increased when the current had reached a predetermined point, or a metallic resistance which had its various sections short-circuited by a series of relays so arranged that the relays cut the resistance into the rotor circuit when the current had reached the predetermined limit.

For the sake of simplicity it was assumed that the fall in speed of the motor or slip below no-load speed was proportional to the power which the motor was giving. Within the limits of fall in speed or slip of the motor, it could be assumed that the stored energy given up by the flywheel was proportional to the slip, without involving any large error, therefore, the power given by the flywheel was proportional to the rate of

*Abstract of paper read at the Institution of Civil Engineers, London, Eng., February, 1912.

change of the slip or to the rate of change of the motor power. Thus, if a sudden increase of load was imposed on the motor and flywheel by placing a bar between the rolls, and a curve was constructed showing the increase of motor power with the time, this curve would be a logarithm curve; while if the power required by the mill suddenly decreased owing to the bar leaving the rolls, the motor power decreased also, according to a logarithm curve. The curves showing the rise and fall in speed of the motor and flywheel were also corresponding logarithm curves. After the bar left the rolls, the power which the motor gave, while decreasing to the value corresponding to the friction, went to increase the speed of the flywheel, and so replaced its stored energy. These curves were quite analogous to those for the heating and cooling of electrical machinery, the power of the motor, however, rose to practically its full value in a few seconds, while the temperature of an electrical machine took a number of hours to reach approximately its full value.

Intermittent-slip Regulator.

One type of intermittent-slip regulator suitable for direct-current motors consisted of a small motor relay to set in operation a number of relays which successively connected resistances in parallel with the resistance placed in series with the shunt field of the motor. The field of the motor relays was excited by the main current passing through the mill motor armature. If the mill motor was small the main current passed through this field, but if the main current was too big, the field was placed across a shunt in the mill motor circuit.

The action of the intermittent-slip regulator was very different from that of the continuous-slip regulator. It came into action when the power given by the motor attained a certain value, and when this point was reached a very slight increase in power indeed would cause the intermittent-slip regulator to act to its fullest extent.

Theoretically speaking, therefore, the power could be maintained at its average value with a deviation of perhaps less than 1 per cent., so that the power curve was practically, a straight line, and did not rise and fall in accordance with logarithm curves, as was the case with the continuous-slip regulator. Assuming that constant power was required throughout the pass when a bar was between the rolls, and as the power given by the motor was practically constant, the power given by the flywheel would also be practically constant, or in each small interval of time, the same amount of stored energy was to be given out by the flywheel. The speed would, therefore, fall during the pass in accordance with the straight-line law, and would rise again in the interval between passes, also in accordance with the straight-line law, and there would be no logarithm curves for the rise and fall in speed as with the continuous-slip regulator.

The author also discussed the arrangement of motor and flywheel to suit power supply, the Ilgner system of driving three-phase current for merchant mill driving and friction losses.

Economy.

Various economies could be effected by electrical driving when properly applied, but one of the principal economies was that of the cost of power. The electrical drive often enabled cheap power to be used when it could not be transmitted or applied in any other way, and also in many cases it afforded a means of enabling power to be generated cheaply, so that in planning an electrical drive every care should be taken to make use of its natural advantages as far as possible.

In a large city where land was expensive, and where facilities for generating power in each individual works were far from the best, it was generally found to be most economical to buy power from the supply authority where the amount required was not very large, because power could be generated in bulk in a power station and distributed to the various works more cheaply than the works could generate it themselves. Where works were not situated in a city, and where the cost of ground, etc., was much less, it was generally found that the works themselves could generate more economically unless the amount of power required was very small. Where cheap power was available, it must be applied as economically as possible and it would seem from what had been said in the foregoing, that considerable care must be exercised in applying a motor and flywheel to a rolling mill in order to ensure that the power was utilized as cheaply as possible if it was desired to obtain economy in working.

THE CENTRAL HEATING AND POWER PLANT OF McGILL UNIVERSITY, MONTREAL.*

By R. J. Durley, B.Sc., Ma.E., M. Inst. C.E.

ECONOMIC and other conditions have led in many places to the development of central plants for the distribution of heat to large groups of buildings or to districts in towns, and these installations are in successful operation both with and without accompanying electric generating stations. The present Paper describes the arrangement and equipment of a central heating plant, combined with an electric light and power station, designed to serve the various buildings of McGill University. Although only of moderate size, the installation is of interest on account of the somewhat severe climatic conditions and the unusual nature of the service. Attention is called to the fact that the economic possibilities of such a station depend very largely on the relation between the demand for heat and that for electric current.

The University buildings were, up to 1908, heated individually by their own steam or hot water equipment, and took current from the local electric supply company. The coal used for the heating service was necessarily of an expensive kind, and the cost of current was rather high. Economy and improvement in service, therefore, were sought by utilizing cheaper coal in a central boiler plant, and heating the various buildings from one source, employing for this purpose as far as possible the exhaust steam from electric generating sets. The buildings which will ultimately be served have a total volume of about 7,570,000 cubic feet; they contain 81,000 square feet of direct radiation heating surface, need 185,000 cubic feet of warmed air per minute for ventilation, and require as a maximum about 475 kilowats for light and power. The greatest demand for steam for heating and ventilation for all the buildings in cold weather would be about 30,000 lbs. per hour. The station as at present working supplies current to eleven buildings, and heat to five; and the heating service will be extended to all the buildings as opportunity serves. A brief discussion of the systems of heating and ventilation in general use in Canada for large buildings, and a description of the nature of the demand for steam and current for the University purposes, is followed by notes as to some of the problems arising in the design and construction of underground piping systems for steam and hot water.

Power House Equipment.

The McGill power house itself is not of an unusual type, its equipment, including four water tube boilers, three steam electric generating sets, the necessary heaters and auxiliary machinery, and the ordinary apparatus for the switchboard and electric accessories. The heat distribution to the buildings being largely by means of forced circulation hot water, as well as by steam, the heaters and circulating pumps are installed in the engine room, and are at present capable of supplying hot water to 60,000 square feet of direct-radiation heating surface.

*Abstract of paper read at the Institution of Civil Engineers, January, 1912.

REFRIGERATION DEPARTMENT

STEEL PIPE VS. IRON PIPE.*

By P. DeC. Ball.

I HAVE been requested to read a paper on my personal experience with steel pipe versus wrought iron pipe in refrigerating plants, and present same as a personal experience and research only, and in no wise as a technical discourse on the subject.

Wrought iron, as we understood it in our younger days, came from the pudding furnace, while the so-called steel, which, in fact, is only a purer iron, is refined for making pipe skelp by the Bessemer process. The iron ore goes to the blast furnace, mixed with coke and limestone in their proper proportions, the coke burned at a high temperature by a hot air blast. The limestone combining with the foreign matter in the iron ore forms a fluid, which, when cold, turns to cinder, or clinker. The iron being heavier, settles to the bottom of the furnace and is drawn off into molds, making pigs, commonly known to the trade as pig iron, which runs from 94 to 95 per cent. metallic iron. The balance is carbon, silicon, manganese, phosphorus and sulphur, of which less than 4 per cent. is carbon, about 1 per cent. manganese, less than 1 per cent. silicon, 1-10 of 1 per cent. phosphorus, and the balance sulphur.

Manufacture of Wrought Iron.

To make wrought iron in a puddling furnace, the pig iron is melted, in fact. boiled, with an oxidizing cinder. The puddler, or man operating the puddling furnace, with his helper, gathers the molten particles of refined iron together in the form of a ball. The temperature of the furnace not being hot enough to melt the refined iron, it being more infusible than the original pig iron, it soon becomes like putty, and is withdrawn from the furnace, carrying considerable of the cinder mixed with same.

This hot ball of iron goes to the machines and is eventually rolled into bars about one inch thick and of the width desired. These bars are cut and piled four or five high, reheated to a welding temperature and re-rolled into a plate of the desired gauge and width. This reduces the oxides and slag to about 2 per cent., silicon .1 of 1 per cent., phosphorus .12 of 1 per cent., sulphide between .01 and .02 of 1 per cent., with a trace of manganese and carbon, as an average for wrought iron used for making standard pipe. However, as one puddler can handle only from 400 to 500 pounds at a time, it is not of even texture, and, from the method of manufacture, there are bound to be more or less laminations when made into pipe skelp.

Manufacture of Soft Steel.

To make what is known as soft steel, which is only a better iron, the pig iron is taken in many times larger quantities to the mixer, instead of to the puddling furnace, melted and mixed by agitation. From there is goes to the converter, where air is forced through the melted pig. Blowing this air through one molten mass immediately causes oxidization, the silicon and manganese being first attacked, and increasing the temperature of the iron. As the temperature increases the carbon begins to oxodize rapidly, and as the iron gets hotter, the change in color of the flame tells when the reaction has been effected, and the metal is drawn off and special treatment given to cause the best results for welding purposes. The slag and cinder rise to the top and the iron is drawn off into molds, making large ingots; the result being that these ingots weigh from 8 to 20 times as much as the small balls of iron puddled by hand, the characteristic difference being about as follows:

Wrought iron has a trace of carbon, while soft pipe steel has approximately .07 of 1 per cent.; wrought iron has .15 of 1 per cent. of manganese, while pipe steel has .30 of 1 per cent.; wrought iron has about 2 per cent. of oxides and slag, while pipe steel has less than .15 of 1 per cent.; showing that steel which is made into pipe and the pipe designated as "steel pipe," is, in fact, a purer iron than so-called "wrought iron pipe." This can easily be proven by heating a piece of steel pipe to a high temperature, chilling it suddenly in water and then crushing it. If it had the true characteristic properties of steel, it would show same if fractured.

It is therefore apparent that so-called steel pipe is made from a purer iron than wrought iron pipe, and, from an engineering standpoint, more desirable, as it is a more uniform material, easy to weld, and the finished product more regular, smooth in appearance, with no blisters or laminations; while wrought iron pipe is not regular in quality or material, owing to difference in pig iron used, small amount puddled at one time or in one heat, and the skill of the puddler entering into the situation, to say nothing of the laminations caused by the method of manufacture hereinbefore mentioned, which are so difficult to detect after being made into pipe.

Wrought iron will vary from four to sixteen per cent. in elongation, whereas steel may be expected to range between nineteen and twenty-five per cent. Puddled iron pulled transversely seldom gives 35,000 pounds per square inch tensile strength, and the elongation and reduction in area are proportionately low and variable.

The bulk of pipe which refrigerating engineers have to deal with is from two inches in diameter down, and is made by the butt-weld and lap-weld process. One and one-quarter inch pipe and under is butt-weld, unless redrawn. In butt-welding small pipe, the skelp or plate is heated to a welding temperature throughout, and drawn through a bell-shaped ring; the edges of the plate are forced together and welded, passed through rolls to give the correct outside diameter, and then through the cross rolls to straighten and finish. After cooling, the ends are cut off, threaded and tested. As the hydrostatic test is made by blanking each end of the pipe with two tight heads, laminations in wrought iron pipe are seldom detected.

Lap-welding consists of two operations. The skelp or plate is heated, passed through rolls and the edges chamfered or beveled, bent longitudinally so that the two beveled edges overlap, forming the pipe roughly. It is then heated again to a welding head and goes through the welding rolls. A mandrel, or oblong piece of cast iron, is held in position between the rolls, so that the welding takes place on the mandrel and between the rolls; the skelp at a welding temperature passing over the mandrel, between it and the rolls. This reduces the lap where the original plate was beveled to the same thickness as the rest of the plate, and welds same thoroughly, which in lap-weld pipe is approximately as strong as any other portion of the wall. While still hot it goes to the sizing rolls, straightening rolls, etc., through the same process as butt-weld pipe.

*Abstract of Paper read before the American Society of Refrigerating Engineers, St. Louis, 1911.

The steel pipe, owing to its being made from a more regular material, and of purer iron, has more ductility and comes out a smoother finished product than the iron pipe.

We have found from personal experience that steel pipe is threaded or chased as readily and perfectly as wrought iron pipe, providing the dies or cutters have the proper rake. Dies for threading wrought iron pipe require much less rake, only about 12 degrees, than dies to chase steel pipe which, to get best results, should have about 18 degrees rake. It, however, requires approximately 6 per cent. more power to thread steel pipe when proper dies are used. As, however, the torsional strength of steel pipe is much greater than wrought iron pipe, there is much less danger of twisting steel pipe or opening the weld during the process of threading.

Resistance of Material to Corrosion.

We have now to consider the resisting qualities of the material to corrosion —wrought iron, with its laminations and slag, soft steel almost a pure iron, regular in quality and material. Our personal experience covers since 1878, when only wrought iron pipe was made. It was of various sizes and thicknesses, depending upon the mill it came from, some large outside, others small, again, with blisters inside, especially larger pipe, caused by laminated skelp.

In ice-making and refrigerating brine tanks, where the pipe was at all times submerged in brine, this pipe gave no trouble from pitting or corrosion, but in submerged condensers we more especially noted heavy pitting in spots. The conclusion we came to in the latter 80's was that of galvanic action—the metal positive, mill scale or slag negative. This conclusion was borne out later by the tests of the Bureau of Steam Engineering of the Navy Department.

In our personal experience we have never known submerged pipe, iron or steel, to corrode in an ice tank or brine tank to an extent to cause trouble, and we have taken out coils in these tanks after fifteen years' service, both iron and steel, and used the pipe in making new coils. This does not apply where the practice is to expose the pipe for several months in the year to the oxodizing effect of salt, air and moisture, as is done in some plants.

The surface or open air type ammonia condenser is of necessity exposed to all corrosive effects, air contaminated by all gases, sulphurous included, and water containing all minerals, heat and cold. We as yet have been unable to find wherein steel pipe is not as good as, or better, than wrought iron pipe, and believe that each particular case of corrosion is caused by local conditions, such as stray electrical currents or contaminated air or water, as stated. We have found as high as 30 per cent. of genuine wrought iron pipe defective, and never more than 7 per cent. of steel pipe, the average steel pipe defective at 500 lbs. air test under water being less than 2 per cent., and generally this defect from the mill being too economical and cutting the pipe too near the tong end.

Iron pipe, however, when it runs bad, runs very bad. This, we think, is caused by the large variation in quality of material, and especially as now it is the practice to use steel scrap of various composition, and the slag is not always uniformly distributed. We call to mind a case where the pipe made up into coils and tested under water showed many leaks from end to end, sometimes in the centre only. The pipe was so bad we sent a portion of it back to the mill, and had a sample tested to see if it really was wrought iron. It was wrought iron, and the mill came back and stated they had tested the pipe to bursting and could find no leaks in same. We again tested other pieces which leaked, and the same leaks developed. We then had a man come from the mill to see this pipe tested. Some of it leaked so badly it blew the water out of the testing tank. We then tested the pipe as is done in the mill by blanking each end, and the pipe was absolutely tight. Upon close investigation we found the iron laminated, the air going into the laminations in the wall of the pipe at the ends, and coming out through many holes caused by slag and other impurities in the centre of the length. When this pipe was screwed up into fittings it necessarily leaked badly. When the ends were blanked off and the wall of the pipe sealed at the ends, as is done at the mill, the pipe showed tight. You can imagine what this would do if the mill had galvanized this pipe, the spelter soldering over defects in the centre of the pipe, and therefore showing no leak under air pressure. But the ammonia, which would soon eat out the spelter, would certainly give the engineer, as well as the contractor, trouble.

Galvanizing steel pipe, owing to the uniform quality of material, absence of slag and laminations, makes it ideal for ammonia condensers, while galvanizing iron pipe for the same purpose is a trouble-maker, for the reason that the pipe is pickled or cleaned by sulphuric acid, hot, that eats off the mill scale and any slag it can find, and sometimes into the interior of the pipe, which is then galvanized. It stands the air under water test, is made up into condenser stands, erected and put into operation. The ammonia decomposes the spelter, with which the pipe was galvanized, and the leaks begin, and the engineer's trouble at the same time.

We last year took down, moved and rebuilt an open air ammonia condenser which had been in operation fourteen years, and which was made of steel pipe, full card weight, not galvanized. The pipe was in absolutely perfect condition, neither pitted nor corroded at all—in fact, looked as good as after the first three months' run.

Pipe Experiences.

From thirty-three years of personal observation, constructing, erecting and operating ice-making and refrigerating machines, absorption and compression types, and using iron pipe for the first fourteen years, and iron and steel pipe for the next nineteen years, we are convinced that local conditions, only, govern the corrosion of pipe in refrigerating and ice-making machines, and that chemically and mechanically mild steel pipe meets the requirements of the refrigerating engineer in all respects and better than any other pipe, for the reason that it is superior in point of finish, body, strength, strength of seam, and uniformity of material.

We think we are borne out in our conclusions by the fact that our understanding is that more than 90 per cent. of all tubular goods are to-day made from mild steel, and that the specifications for "genuine wrought iron pipe," which some purchasers of refrigerating machines specify, require a careful personal supervision of the contractor or his engineer to see that his contract is filled as specified.

REMARKABLE OIL-ENGINE TRIALS

One of the units of the machinery which is to be installed in the vessels which Messrs. Barclay, Curle, and Co., of Whiteinch, Glasgow, have built for the East Asiatic Company of Copenhagen, has passed successfully through a remarkable trial. The vessel is to have Diesel oil engines of about 3,000 h.p. There will be eight cylinders driving each of two shafts, and the cylinders will be arranged in series on their respective shafts, the design of the installation being such, that, should any one cylinder or more break down, the shaft can be driven by those which remain in working order. The firm have just concluded a 30 days, full load, non-stop (night and day) trial of one of the units. During all the trial the machinery ran without the slightest hitch, and when it was opened out for examination it was found in such perfect condition that it could quite well have been re-started, without adjustment of any kind, on another run of equal length. This is said to be the longest reliability trial of such machinery of which there is any record. It is equivalent to a longer non-stop voyage than is now called for in any sea-going services except on a very few routes. It may be added that the trial was run with ordinary Scotch shale fuel oil, and that the average consumption was 0.35 lb. per i.h.p. per hour.

THE READERS' POINT OF VIEW

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

INTERNAL COMBUSTION ENGINES.

By A. F. White.

THE object of this paper is to fully explain the different principles and methods of governing the modern gas engine. The governing of an engine means the control of the power which it is developing, or, in other words, to

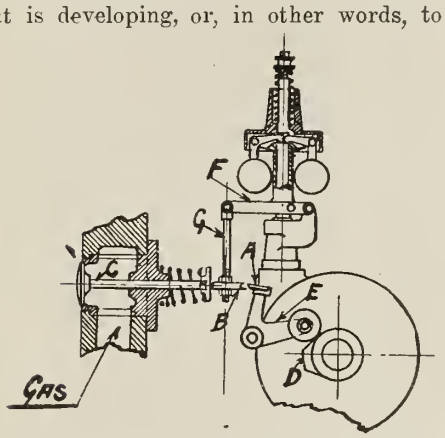


Fig. 1—Internal combustion engines.

proportion the expenditure of energy so that the speed is maintained constant. If the engine develops more power than is required it will speed up, and if the power delivered to the crankshaft is less than the resistance there, the engine will slow down. Good governing is one of the essential requirements of any engine. One of the many objections urged by critics and opponents was that of irregular running of the gas engine, but it is now an indisputable fact that through the persistent and tireless efforts of many capable designers and experts, the modern gas engine does not give greater speed fluctuation than is accepted by the best steam engine practice. Modern developments have evolved the multi-cylinder engine, both in horizontal and vertical types, and there is now no limitation of gas engine driving. For direct or alternating current generators in parallel, no difficulty is experienced.

The controlling mechanism, or the governor on a gas engine does not differ greatly from that used on a steam engine, but there is considerable difference in the way in which it controls the work done. In either case the governing is effected by varying the impulses or the strength of same on the piston relative to the work performed. With a ready-made medium, such as steam, having a somewhat constant pressure, this requirement can be easily fulfilled, but in the case of a gas engine with no prepared or fixed dynamic medium, the combustion or explosive mixture has to be formed for every individual power stroke. This requires considerable exactness in the preparation of the mixture and imparts to the governing organs a pronounced significance. There are two general methods in use with gas engines for varying the power; one by varying the number of explosions or impulses per minute, known as the "hit and miss" system. The other, by varying the magnitude of the impulses while keeping the number per minute constant, is called the variable impulse system, or, more commonly, throttle governing.

The Hit and Miss System.

The hit and miss system has now been practically abandoned and superceded by variable impulse governing, except on small engines, owing to the cyclic variation of the former being too great, and because no finer graduation of adjustment can be made on a four cycle engine than by missing four revolutions of the crankshaft with a cut-out

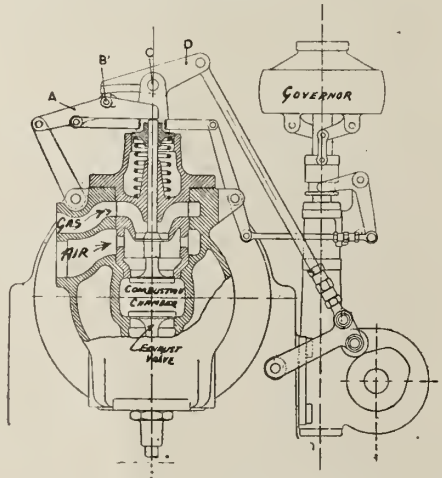


Fig. 3.—Internal combustion engines.

on the governor; hence, a very heavy flywheel is apparent even to gain a reasonable degree of regulation.

The omission of the explosion is usually brought about by keeping the gas admission valve closed so that air alone is taken in during the admission stroke. This may be performed in many different ways. One method is illustrated by Fig. 1. In the position shown, the striker A will engage with

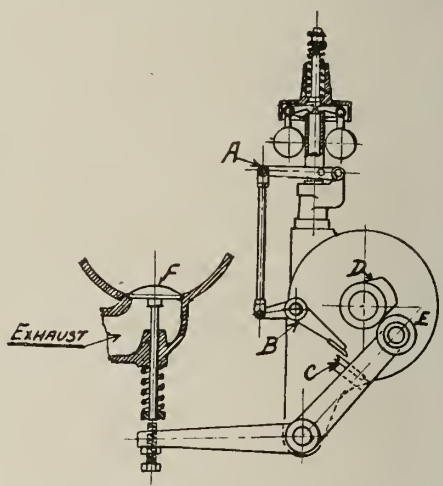


Fig. 2—Internal combustion engines.

striker blade B, causing the gas valve C to lift at the beginning of the admission stroke by the cam D and lever E. If the engine speeds up, the centrifugal force of the governor balls will raise the lever F and rod C with striker blade B attached. The striker H will then miss the striker blade B, consequently the gas valve will remain closed, therefore the cylinder will be filled with air only and there can be no explosion on the cycle.

Another method of cutting out the explosion is shown by Fig. 2. This is only used on very small engines which have an automatic admission valve. With this system, when the speed reaches a point above its normal, the governor raises the lever A, causing the lever B to engage with the notch in lever C when the cam D is just leaving the roller E, thus propping the exhaust valves open on the suction stroke. This, of course, destroys the vacuum in the cylinder and consequently there is no suction on the automatic valve, which remains closed during the following suction stroke and no impulse is obtained

until the admission valve is allowed to operate.

Variable Impulse Governing.

This system of governing is effected by varying the strength of the charge with an impulse at every ignition point, therefore, the control has to be such that the mixture is always an explosive one. There are two distinct methods of variable impulse or throttle governing, namely, quality governing and quantity governing. There is not much to be said against either type as both give excellent results.

Quality governing consists of varying the proportion of gas to the air. This is brought about by varying the lift on the gas valve or throttling the gas, thereby weakening the explosion. The total volume of mixture sucked into the cylinder at each charge remaining the same. This permits the compression being kept constant. Some makers claim a higher thermal efficiency with this system than with quantity governing. This advantage is somewhat offset when using a weaker gas, as great trouble is sometimes experienced, due to back firing, owing to the limited range of proportions of gas and air to ensure perfect combustion of a charge. A very lean mixture will prevent ignition, hence a back fire.

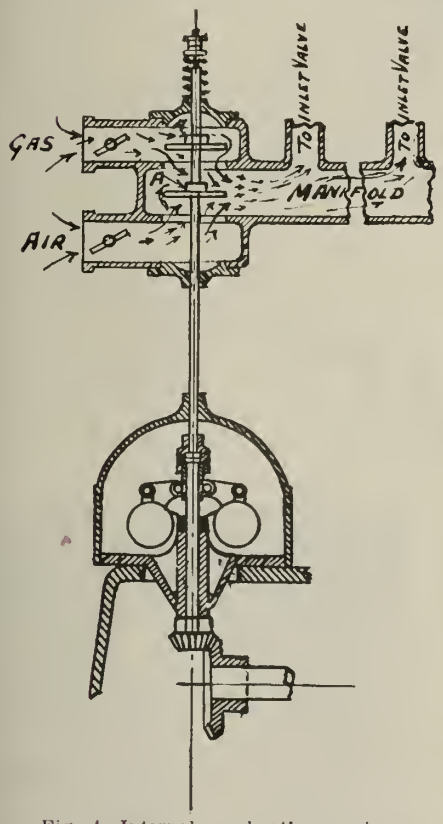
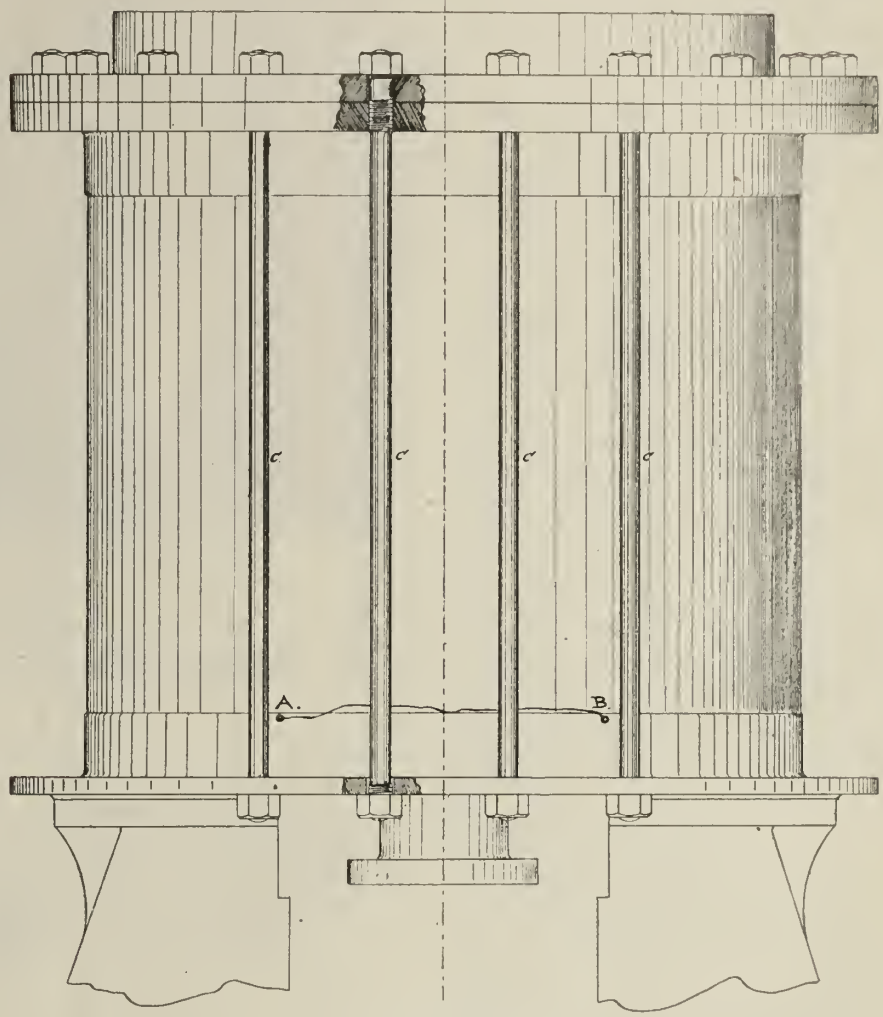


Fig. 4—Internal combustion engines.

Quantity governing is the most popular form of governing, the majority of makers having adopted this system. This may be accomplished either by straight throttling the mixture (gas and air) through the whole length of the stroke, or by using a variable cut-off arrangement in connection with the governor, which allows the charge to be cut-off at a certain point in the stroke corresponding to the load. The compression is thus decreased and a smaller volume of constant quality mixture is taken into the cylinder, giving a weaker explosion governed by the amount of cut-off. This affords close regulation and gives the same composition of mixture at all loads. A good example of the cut-off type throttling gear is shown by Fig. 3. The combined gas and air valve is actuated by the lever A, which again is operated by the lever D at the roller B; this is shown at its maximum full stroke. As the speed increases, the heavy spring loaded governor draws the lever H in towards the centre G, thus shortening the stroke of the valve, consequently diminishing the volume of mixture, also the explosion and mean effective pressure. Fig 4 shows an arrangement of the straight throttling type of governing as used on multi-cylinder vertical engines. The gas and air is throttled by the double seated valves AA, similar to a common steam engine gear. The inlet valve of each cylinder is connected to the manifold and a uniform quantity of mixture is taken into each cylinder according to the power required.



A Cylinder Repair.

A CYLINDER REPAIR.

By Geo. E. MacColl.

THE L. P. cylinder of a coasting steamer's engines was found to be cracked on the wall as shown at A.B. on the accompanying illustration, and it was necessary to repair this in such a way as would enable the vessel to be kept running until a new cylinder could be east, machined, and made ready for installing.

It was first suggested to fit a patch over the crack, secured by tap bolts, but this was not considered entirely satisfactory. The firm who were to make the repairs proposed and carried out the following alternative method. Four of the cylinder cover joint studs were removed, and in their place, four studs, C,C,C,C. having long bolt ends, were fitted; the end of each being carried down through holes drilled in the bottom flange of the cylinder, as shown, enabling a heavy pull

to be got between the two flanges, which kept the crack closed. The bolt ends were tightened up when the cylinder had expanded under thorough heating up.

This simple and inexpensive repair was completed within the space of a few hours while the vessel was discharging, and did not cause a moment's delay in her sailing. It proved thoroughly effective, so effective indeed that had the underwriters not already agreed to the cost of removing the fractured cylinder, the old cylinder as repaired would have lasted out the life of the engines. A hole was, of course, drilled, tapped and plugged at each end of the crack to prevent its extending.

MECHANICAL vs. HAND BOILER ROOM EQUIPMENT.

THE following estimate shows the saving by using mechanical chain grate stokers and complete coal and ash handling equipment against hand boiler room labor. It is based on an investment of $47,600 for automatic equipment.

$5,000 H.P. PLANT.

With stokers and automatic coal and ash handling machinery.

3 head firemen @ $80 per month	= $240.00
6 firemen @ $75 per month	= 450.00
2 ash men @ $65 per month	= 130.00
4 men unloading coal @ $65 per month	= 260.00
Interest and sinking fund	= 365.00
Power and labor	= 100.00
Maintenance	= 25.00
	$1,470.00

WORK PERFORMED BY HAND.

8 men unloading coal @ $65 per month	= $520.00
12 men getting in coal @ at $65 per month	= 780.00
18 firemen @ $75 per month	= 1,350.00
3 shift foremen @ $80 per month	= 240.00
6 men taking away ashes @ $65 per month	= 390.00
	$3,280.00
Work done by machinery	= 1,470.00
1 month's saving	$1,810.00
	12
1 year's saving	$21,720.00

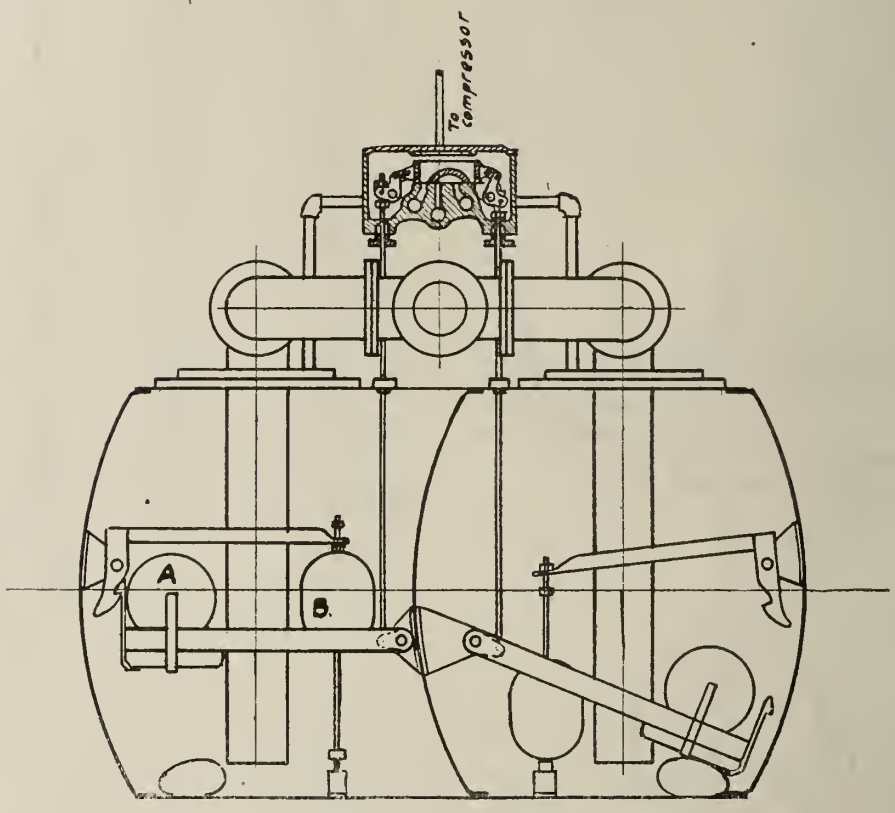
The figures are compiled from actual cost by J. F. McCall, Supt. Power Department, Calgary Municipal Power Station, Calgary, Alta.

AIR-DRIVEN PUMPING PLANT.

By J. A. A.

AT the waterworks of the City of Hamilton, Ont., there has recently been installed and put into operation, a device for raising water to the mains at the level above the mountain. It utilizes the energy of compressed air, there being no moving parts outside of the necessary valve gear. The air for operating this lift is supplied by a small compressor and is stored in two tanks 6 ft. diameter by 32 feet, so that the compressor need not be run continuously.

The apparatus consists of a tank 4 ft. dia. by 6 ft., divided by a bulkhead in the centre, as shown. This tank is placed in the basement so that the water flows into it under a slight head, the operating valve being placed on the floor above. Suppose the left-hand compartment to be filling with water, the float A rises as shown, and by means of the vertical brass rod and bell crank in the valve chest, throws the slide valve to the right, admitting air into the left-hand port, and thence by way of the small 1½-in. pipe into the full end of the tank. The compressed air forces the water out



Air Driven Pumping Plant.

and by an arrangement of check valves, discharges it into the 6-inch outlet pipe. At the same time, the right-hand port is connected to the centre exhaust port and the air exhausted from the right compartment, thus allowing it to fill with water. As soon as the float in this side rises sufficiently, it throws the valve to the opposite side and the operation is reversed.

The secondary float B is arranged so that it descends with the falling water and strikes a collar on the rod, which passes through it, unlatching the main float by means of the upper lever, and allowing the float A to drop. This throws the valve across quickly to the opposite position so that it cannot stand central. An elliptical spring is attached to the bottom of the tank, to catch the oak timber below the float and absorb the shock. The space in the valve chest is filled with oil nearly to the top of the valve, ensuring an airtight joint.

This outfit was built by the John Inglis Co., Toronto, to the order of John Montgomery, of the C. N. Ry., who designed and installed the mechanism.

BELLEVILLE, ONT.

On February 8, Belleville Lodge, No. 34, C.A.S.E., held its annual banquet. Lt.-Col Marsh was chairman, and filled the position with dignity and efficiency. His opening remarks expressed delight in sharing the festivities of the annual banquet and at meeting the engineers in whom he always took a deep interest as a manufacturer. After the toast of "Our King" had been duly honored, that of the "City of Belleville," was proposed. In the absence of Mayor Vermilyea, Ald. Chown replied, and in the course of his address expressed pride of Belleville and its various industries, all of which were supported by local capital, and whose products were known throughout the whole of Canada. Continuing, he said, "he was glad to see men organized for the purpose of making themselves more efficient and at the same time better citizens."

Mr. W. C. McGhie replied to the toast of the "Engineers' Examining Board," and took occasion to refer to the educational policy initiated by the Board and

the immunity from boiler explosions being enjoyed in the Province of Ontario since the passing of the Act. "The Manufacturers and Steel Company of Canada," toast was proposed by the chairman and replied to by Mr. Higgs, of the Rolling Mills staff. The toast of "The Ladies," was responded to by Messrs. F. H. Chesher, Bert McCoy and Mr. Stott; that of "The Coming C.A.S.E. Convention" at Belleville on July 23, 24, 25, of this year, by C. J. Peppin and R. McCrodan; and the "Local Lodge No. 34, C.A.S.E.," by Mr. William Cooke. A varied programme of vocal and instrumental music was carried through between the proposing of the various toasts and a most profitable and enjoyable evening was brought to a close just before midnight by the singing of the National Anthem.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the recent annual meetings of the Canadian Society of Civil Engineers over 100 members participated in a visit to the C.P.R. Angus shops, the Dominion Bridge Works and the Canadian Car and Foundry Co. The delegation was divided up into two parties.

Mr. H. H. Vaughan, assistant to the vice-president of the C.P.R. had charge of the party which visited the Angus shops, a special train being in waiting at the Windsor street station to convey the party. A dining car was attached, luncheon being served after the inspection was over.

The second party under the guidance of Messrs. F. Johnston and G. H. Duggan left by special M.S.R. cars from the Windsor Hotel. The works of the Dominion Bridge were first visited and after luncheon there, the party left for the Canadian Car Co. Works. In the evening the annual banquet took place at the Windsor Hotel.

JAMES STOTT.
President, Belleville No. 34, C.A.S.E.

F. H. CHESHER.
Past President, Belleville No. 34, C.A.S.E.

23rd ANNUAL CONVENTION C. A. S. E., BELLEVILLE, ONT.

The 23rd annual convention of the Canadian Association of Stationary Engineers will be held in Belleville, Ont., on July, 23, 24, 25 of this year. Arrangements are well in hand for this important function, and it is no secret that determined efforts are being put forth to make the coming meetings top-notchers in every respect. Our illustrations are those of prominent men in Belleville, No. 34, C.A.S.E. We understand that the civic authorities, manufacturers, and the public generally are entering into the project with great heartiness, and those who are privileged to attend the convention may rely on finding a treat in store for them. In subsequent isues we will supplement the foregoing information.

WATCH THE LABEL ON YOUR PAPER.

So heavy has become the work in the subscription and circulation departments of our various papers that we are unable adequately to keep up with the work of sending receipts to all subscribers for subscriptions received. Some time ago, because of this congestion, we were forced to select a new plan with our trade papers by notifying our readers who sent in money for subscriptions to watch the address label of their paper and see that the date of expiry of subscription was changed. This plan has worked well with the papers which adopted the scheme, the changing of the date being sufficient notification to the subscriber that his subscription had been received.

In future, instead of sending out receipts for money paid on subscriptions we will simply change the expiry date on the paper going to the subscriber. If your paper does not have the label changed on the next or following issue after payment of subscription, drop us a post card and the error will be rectified immediately. Watch the label on your paper.—The Power House.

FUEL ECONOMISER EXPLOSION

A report on the explosion of a fuel economiser has recently been issued. The explosion was caused by the failure of a cast iron cross bar through which the bolt for securing one of the tube sight hole caps was passed. The cross bar was a three-legged one, and, from the appearance of the fracture after the explosion, it must have been broken for some considerable time, being held in position by friction only. It ultimately became slack by vibration, and, falling away from its position, the cap was blown off by the pressure within the economiser. This method of securing externally fitted caps to economisers, the engineer surveyor-in-chief points out, is not a desirable one. The economiser was, however, about twenty-nine years old, and the method has been practically discarded by makers of the newer type of apparatus

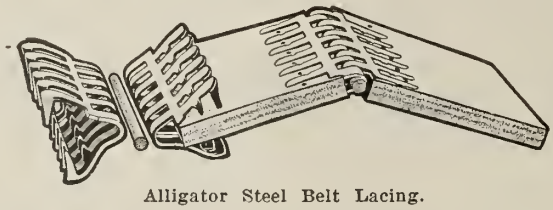
WM. COOKE.
Secretary, Belleville No. 34, C.A.S.E.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

ALLIGATOR STEEL BELT LACING.

THE requirements of every modern manufacturing plant demand the risk of shut-down to be not only reduced to a minimum as regards frequency, but at the same time, when the unavoidable does happen, that the period be restricted to the utmost in duration. Belt drives, from time to time, necessitate, due to repair requirements, it may be, either the stoppage of a single machine, a sectional group of machines or perhaps the whole factory, should the main drive belt give out. In such circumstances, the enforced idleness means a lesser or greater loss, and naturally it is the part of wisdom to not only have efficient operative equipment ready for the emergency, but also such as is easily and quickly applied. The alligator steel belt lacing which we illustrate and describe, is claimed to fulfill both these purposes admirably, in addition to other attractive features. Official tests go to show that the "Alligator" joint has a strength equal to 60 or 70 per cent. of that of the best grades of belting procurable, and that the joint is in every respect, perfectly flexible.



Alligator Steel Belt Lacing.

Alligator steel belt lacing is adaptable for use on leather, rubber, balata, cotton or canvas-stitched belting, and consists of a separable lacing, hinging on a raw-hide or sectional steel rocker pin.

The flexible joint insures quick contact with the pulley, whether the belt is run with either or both sides in service, and as the lacing engages both sides of the belt alike, the strain is thrown in direct line of the pull, making a joint which is easy on the belt, and where applied according to directions will stand any belt strain, under any conditions of service. With rubber or textile belting this lace overcomes the tendency to fray at the ends, as the members of the lace clamp the stub so as to protect them. It will work perfectly in contact with an idler, and no punch holes are required.

The teeth on each side of the lacing enter the belt on different lines of perforation; each prong has two teeth, the longer clinching through belt, the shorter point on opposite side of prong, giving great additional strength. Both enter the belt so that the pull is against the edge of the steel and not against the flat. This avoids weakening the belt, and in rubber and textile belts does not cut the long threads in which lie the strength of that class of belting.

Being separable, this lacing is especially adapted for use on overhead belts, the ends can be dropped down, the lacing applied and hinge pin inserted after belt is returned to shafting; by taking out pin, belt may be temporarily removed from service, lengthened by inserting a stub section of belting or shortened by cutting off excess from one end and using half of a new lacing.

The connecting bar between the prongs is indented on the under side to allow it to be broken into required lengths (cutting pliers not being required) and the use of a single section on any width of belt up to 12-inch. The indentation also insures that in use over heavily crowned pulleys the bar may be broken without weakening the lacing, as each indentation separates a full staple which retains its efficiency.

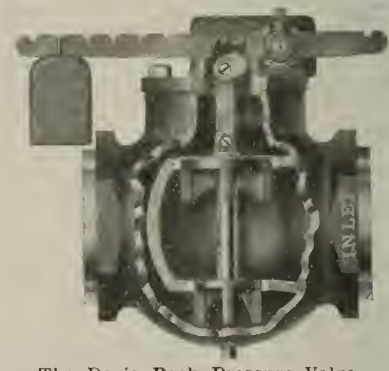
The sectional rocker hinge pin consists of two specially formed steel wires having oval faces with lugs on back to fit in between loops of the hinge and keep it from working out. In service, the sections of the pin remain stationary in the loops of the lacing and give the necessary flexibility to the joint by rocking on their oval faces. When using the rocker pin, cut two pieces just alike, same length as bar of lacing, having small lug at one end; reverse one piece, put smooth faces together, as shown in cut, and insert in lacing with round back fitting the loops of lacing, having lugs between loops of hinge.

The "Alligator" steel belt lacing is made by the Flexible Steel Lacing Co., Chicago, and the Canadian agents are the Crescent Oil Co., Hamilton, Ont.

THE DAVIS BACK PRESSURE VALVE.

A BACK pressure valve with a semi-balanced disc is either liable to stick and cause trouble or else it can't possibly stick. This depends altogether upon its design. It is a well-known fact that brass expands more than iron, therefore, if an iron plug be closely fitted at top and bottom with brass rings and heat applied, the rings will expand away from the plug. While the rings were a tight fit when cold, they become loose on the plug when heated.

That principle is adopted in the construction of the Davis back pressure valve. The seats are bushed with brass rings, and the disc is made of iron. When heated by steam, the seat rings expand more than the disc, so there is no possibility of it sticking. It is claimed that no other make of back pressure valve with a semi-balanced disc is made in this way. The designs and construction was patented several years ago by the



The Davis Back Pressure Valve.

G. M. Davis Regulator Co., Chicago. Since that time, large numbers of them have been sold, and all are in successful operation to-day.

This valve is made in sizes from 2 to 36 inches, for use in either a horizontal or vertical run of pipe, also in angle pattern, with the inlet on the bottom or side. Sizes from 2 to 12 inches inclusive, may be had with screwed or flanged ends, while the larger valves have flanged ends only.

THERMO-FEED BOILER FEED REGULATOR AND DIFFERENTIAL GOVERNOR.

ANYTHING that will reduce the range of water level in a steam boiler must of necessity tend towards economy, and it is stated that the new form of regulator, here described, gives full control from zero to full feed within a range of ⅛ inch of the water level. Fig. 1 shows the float directly coupled by pairs of levers to the control valve, which has been placed in a vertical position high up, and thus out of contact with any scum which might collect on the surface of the water. Furthermore, the valve and operating gear is made readily adjustable from the exterior for variation of water level, and is so constructed as to be easily taken to pieces for examination and repair. The particular method of making the double-seated valve and valve seats as a self-contained part enables a spare device to be kept in stock and changed at very short notice and in a few minutes.

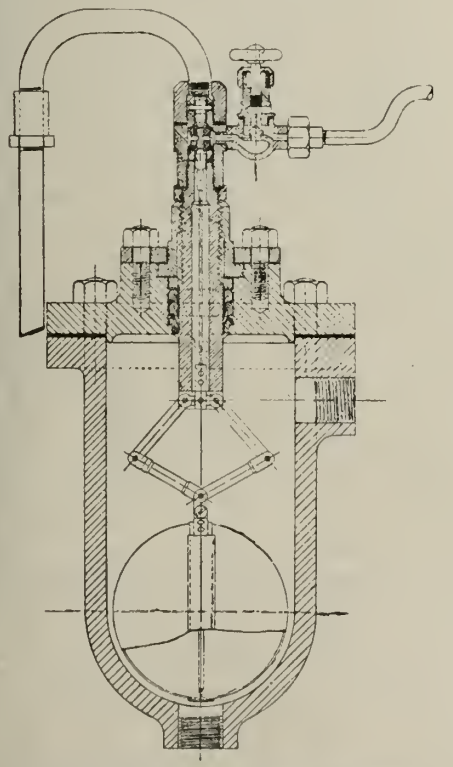


Fig. 1—Thermo-feed Boiler Feed Regulator.

The feed check valve control device is materially modified in the direction of substituting a cylinder and piston with a Sea Ring cup in place of a flexible diaphragm, and in arranging the spring at the upper part and at the side of the device away from the heat instead of about the valve spindle. This not only renders adjustment of the spring a simple and easy matter, but also leaves the gland nut free for removal for repacking without dismantling the device as a whole.

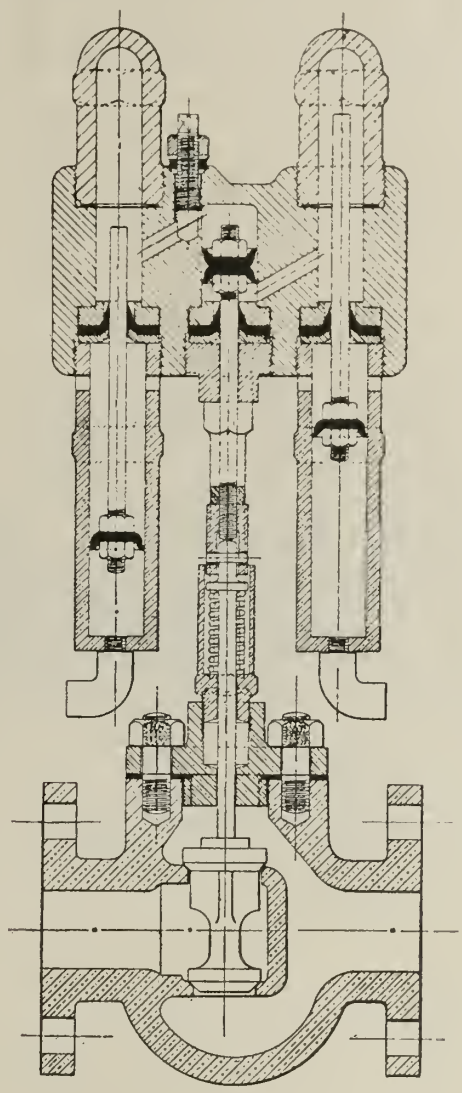


Fig. 2—Differential Governor.

The lever can be used, if necessary, for operating the check valve by hand for independent control, a tommy bar being inserted in the socket to increase the leverage if desired. In order to provide automatic means for controlling the admission of steam to the steam pump when feeding, for example, a battery of boilers fitted with Thermo-feed regulators, an ingenious form of differential governor has been designed, which we show in Fig. 2. The valve indicated here is the admission valve on the steam supply to the pump and is spring pressed so that it tends to open and admit steam to the pump. The valve spindle carries a piston at its upper end, which works in an oil cylinder, having an upper communicating passage leading to a left-hand ram and a lower passage leading to a right-hand ram. The left-hand ram is attached to a piston working in a cylinder connected with the feed pipe line and a similar piston in the right-hand cylinder is in connection with the steam pressure driving the pump.

So long as the pressure in the feed pipe line is only sufficient to feed the boilers, the steam valve to the pump is maintained open by the spring, but when the feed delivery is checked, the pressure rises and acts on the left-hand piston against the steam pressure on the right-hand piston, and the oil acting as the transmitting medium causes the valve piston to descend and close the steam valve more or less, until the flow of feed water into the boilers is again increased and the pressure reduced, when the differential pressure opens the steam valve again and the pump increases its rate of action.

By a combination of the two devices described, the supply of feed water to a battery of boilers by a steam-driven pump is automatically controlled in an absolutely reliable manner

The apparatus is manufactured by Ronald Irish & Co., Lloyds Avenue, London, England.

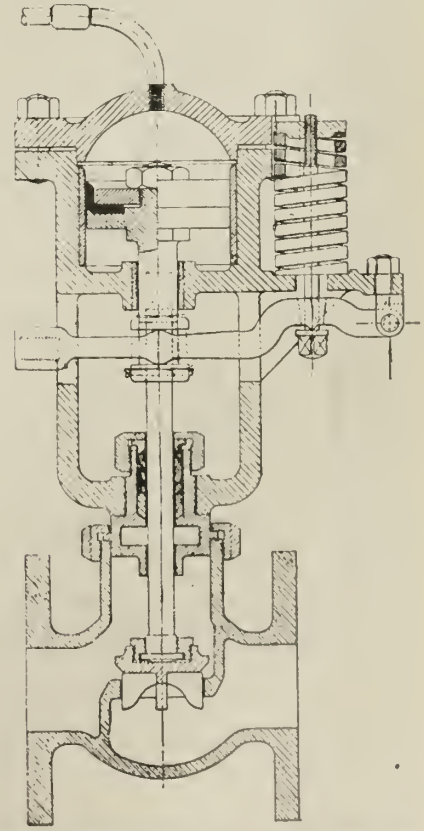


Fig. 1—Thermo-feed Boiler Feed Regulator.

PEAT AS A FUEL.

THE results of an investigation undertaken to determine whether peat, a fuel widely used in some countries, could be serviceable in the United States are contained in a bulletin, "The uses of peat for fuel and other purposes," recently published by the Federal Bureau of Mines. The author of the bulletin, Charles A. Davis, the peat expert of the bureau, gives an exhaustive review of the entire problem, both in the United States and in Europe, and draws the conclusion that the American peat beds are a great and neglected resource, which, when properly and fully developed, will add to national wealth no inconsiderable quantity of good fuel and of raw material for important arts and manufactures.

Mr. Davis tells frankly about the good and bad of peat. He declares that the difficulties that have always been encountered in utilizing peat for fuel are due to the fact that in its natural state, peat contains only about 10 per cent. of combustible matter, the remaining 90 per cent. more or less being water. He also says that in the last few years, more than $1,000,000 has been spent in erecting plants and in experimenting with peat, and that these efforts were unsuccessful:

"Because the closing of larger plants before they had reached a stage of demonstrated success was so general," says Mr. Davis, "more conservative developments have been planned for making a thorough trial of the material in favorably situated places under American conditions of production and fuel supply."

Mr. Davis estimates that there are more than 11,000 square miles of land in the United States having peat deposits of good quality. He declares that in these deposits there are 12,888,500,000 tons of peat with a value of more than thirty-eight billion dollars, enough peat to furnish heat and power for the entire country for many years.

He is of the opinion that there will soon be a demand for peat as a fuel, at the same time he gives the following warning:—"The foundation of all successful development and growth of peat industries in the United States must be a thorough scientific study of the occurence, nature, qualities and peculiarities of peat itself and a careful and honest investigation of the status of these industries in the European countries in which they have reached self-supporting existence. To begin without these preliminary studies would be the heighth of folly."

Mr. Davis says further: "It is an exceedingly interesting coincidence and a most important economic consideration that the regions where peat is most abundant are relatively remote from the coal fields, the only exception being the overlapping of peat and coal in Michigan. When one also notes that the more northern States, in which fuel is most needed, and the parts of the southern States where other kinds of fuel are not readily available, are rich in peat, it seems strange that a more careful examination into the posibilities of the peat resources of the country has not been made, because potentially they have large value and great possibilities.

"In conclusion, peat fuel may be said to be especially useful for certain purposes for which wood was formerly in general use and for which coal has not yet been altogether successfully introduced, such as brick and other forms of ceramic firing and lime burning. It appears to reach its highest value, however, as a source of producer gas in properly constructed gas producers.

"The fact must be noted that no quantity of peat fuel of any type sufficient to prove its value has yet been produced in the United States; until this has been done, although the outlook and European experience warrant further investigation of its posible uses and value, no final conclusions as to the commercial value of America peat as compared with coal can be reached."

EDITORIAL INDEX FOR 1911

The attention of subscribers is drawn to The Power House editorial index for 1911, inserted at the rear of the present issue. By opening the binder clips on the last page—that facing the inside back cover—the index may be withdrawn for filing or binding along with the numbers for the year to which it refers. On closing the binder clips again, the current issue is kept intact.

THE WATER SUPPLY OF THE WITWATERSRAND.*

By D. C. Leitch, M. Inst. C.E.

The central pumping-station at Zwartkopies contains the steam-driven pumps, boilers and superheaters. There are four sets of main triple-expansion pumping-engines, which are of the vertical inverted type, driving the pump-plungers direct off crossheads. The maximum capacity of each engine is 100,000 gallons per hour, against 960 feet head. There are three high-speed electric generating-sets, each of 360 kilowatts, supplying three-phase current at 3,300 volts. On trial, with a superheat of 500 degs. F., the main engines consumed 11.25 lbs. of steam per net horse-power hour, a record performance; in ordinary working this consumption is increased to about 13 lbs. Current is delivered to motors at the wells at the full voltage of 3,300 to 3,000, by overhead transmission-lines of stranded copper, carried on timber cross-arms and steel poles, which also carry telephone-lines.

The well-pumps are of the bucket-and-plunger type, driven by rods and bell-cranks from a head-gear and motor placed centrally between each pair of pumps. The fly-wheels, on crank-shafts of the head-gears, weigh about 4 tons each, and a considerable saving in cost was effected by constructing them of reinforced concrete from material on the spot. The capacity of the pumps ranges from 45,000 to 8,000 gallons per hour. The electric motors are connected to the head-gear by double-reduction spur-gearing. Six of the motors are of 50 b.h.p. and four of 75 b.h.p. each; the overall efficiency of motor, gear, and pumps is about 70 per cent.

The water pumped from Zwartkopjes to the summit at Turffontein Nek, gravitates to the pumping-station at Village Main Reef. Here, up to 100,000 gallons per hour can be pumped to Yeoville Reservoir, against a head of 270 feet; of the remainder, part is taken by mining consumers before reaching Village Main Reef, and the balance is distributed east and west along the Rand. To accelerate the delivery eastward, a steam-pumping plant, capable of delivering 200,000 gallons hourly against a head of 80 feet is provided. The pumping-engines are of the Worthington duplex, triple-expansion type, with pneumatic compensators, driving the high-lift pumps direct off the crossheads and the low-lift pumps off the tail-rods of the high-pressure plungers; the latter pumps can be readily connected or disconnected. There are also several small electrically-driven pumping stations, drawing supplies; in all about 700,000 gallons daily, from wells. The rising main from Zwartkopies is constructed of 27-inch and 29-inch welded steel pipes, with both riveted and Kimberley collar joints.

As the maximum head may reach 960 feet, the lower portion of the pipe is strengthened by steel-wire binding. The length from Zwartkopies to the summit is about 6¼ miles, divided into four sections by reflux valves of special construction for high pressures. Expansion-joints are provided, and the pipes are protected by a bituminous coating; precautions are also taken against sand cutting. The leakage amounts to only 150 gallons per hour. The distribution

* Abstract of paper read before the Institution of Electrical Engineers, London, Eng.

An American-Thompson Indicator Would Help You Stop Wastes

And the engineer who can stop wastes increases his earning power

Do you get that? Merely looking wise doesn't get promotion and more pay. It's the progressive man who does things with a view to betterment, who seizes opportunities and improves them, who ultimately advances to be a "top-notcher."

Many a business through lack of proper management, yet backed with ample capital, has been forced to suspend, mainly through wastes and leaks that should have been stopped.

The American-Thompson should be in the possession of every prudent Engineer whose ambition is betterment in the plant over which he has control and personal advancement as an indispensable factor in its management.

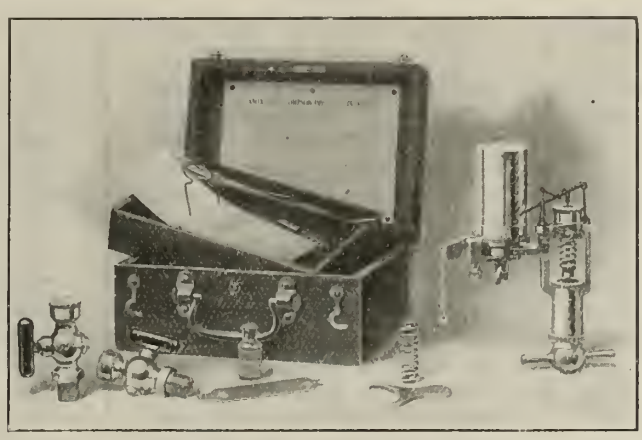
The American-Thompson is the first and foremost aid to the chief. It aids him to develop all that's good and useful, not alone in the plant, but in himself.

Prevention of Waste

In the power plant this is a matter not to be overlooked. The wastes of fuel, break downs, shut downs, loss of time and power, can all be avoided if care and watchfulness are exercised. These are matters of great importance to the concern which pays the bills, and which is quick to recognize any savings that are made.

Many a business struggling for existence could be made profitable through the use of waste matter which had never been considered of any value, and had always been thrown away.

The engineer who can prove his ability to stop waste in the power plant and turn it into profit, vastly increases his earning power and is always in a position to demand recognition.



The American-Thompson is the original Thompson Indicator. It is the most imitated instrument on the market. To be absolutely sure of getting the right indicator, ask for the "American-Thompson Indicator made by The American Steam Gauge & Valve Mfg. Co." Always specify it in that way.

Importance of an Indicator

What would a master carpenter do without a spirit level? How true would be the work installed by him?

You, Mr. Engineer, should study well the import of this. And not alone that, you should know of what great importance an indicator is to you in your profession.

The American-Thompson is an Indicator of the highest quality; it originated with us, has been made solely by us and is backed by more than 35 years of continued satisfaction-giving service.

Your Interests Demand It

There are a great number of points about an American-Thompson Indicator that no other Indicator has in its make-up. For instance, the 3-to-1 pencil motion that no other Indicator dares attempt to imitate.

The Detent motion is another American-Thompson feature, feebly imitated in "just-as-good" instruments.

These and many other features, all of great importance to the Engineer who wants everlasting accuracy in an Indicator, are distinctive qualities of the American-Thompson. The way is paved for you to possess one of these more than useful Indicators, on the easiest kind of easy terms.

Your future interests demand that you take advantage of our liberal offer. Get in the band wagon to-day—our offer is a straightforward proposition.

Price of Outfit

The price of the outfit as shown is $55.00 with reducing wheel $65.00. If you want the detent motion add $15.00. The terms are easy—made easy to put this standard instrument within your immediate reach—$5.00 down, $5.00 per month.

You send $5.00 and two good references; we ship outfit at once and it's yours for examination for 5 days. Don't put this matter off any longer—take up our offer now.

American Steam Gauge & Valve Manufacturing Co.

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GENERAL AGENTS FOR CANADA

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NAME

ADDRESS

system comprises 133 miles of steel mains, averaging 14½ inches in diameter. Provision is made against subsidence over mine-workings. The storage-reservoirs on the Rand have a total capacity of about 10 million gallons. In addition there are settling-tanks at Zwartkopjes, with a total capacity of 6,070,000 gallons, and also two clear-water tanks, each containing 75,000 gallons. These tanks are all uncovered, and are constructed of reinforced concrete. The whole of the water delivered to consumers is measured.

Water Analysis.

The average hardness of the Zwartkopjes supply is about 19 parts per 100,000: this is reduced to 14 parts by the addition of hydrate of lime, a solution of which is added to the water entering the settling-tanks from the wells. As much as 2 parts of iron per million is found in the water from some of the wells which afford the most copious yield. Growth of weed is prevented in these cases by adding 1 part in three millions of copper sulphate; while the oxide, formed as soon as the water is aerated, is removed by passage through a cinder filter. Owing to the occasional presence in summer of B. Coli, probably due to insect sources, it is desirable to have means of sterlizing the water. This is done by the addition of 7½ to 15 lbs. of chloride of lime per million gallons.

The works described were carried out mainly by local contractors, under the direction of the writer, material being purchased in England under separate contracts. The total cost was about $4,500,000.

During the first half of 1910, the difference between the water pumped and water sold was about 6.2 per cent. on a total of 172 million gallons per month, and with about 10¾ million gallons in circulation, in mains and reservoirs. During the second half of 1910, the average demand rose to 235 gallons per month, and the cost of pumping and delivering water to the consumers was 15 cents per 1,000 gallons. Adding to this fixed charges on Rand Water Stock—paid by direct contribution from the municipalities and producing mines—which amounted to 35 cents, the total cost of water was 50 cents per 1,000 gallons.

STEAM TABLES FOR CONDENSER WORK.

PRESSURES below atmosphere are measured in a great many ways; in millimeters of mercury absolute pressure, in inches of mercury absolute pressure, in millimeters of vacuum, in pounds per square inch absolute pressure, in kilograms per square centimeter absolute pressure, in decimals of an atmosphere, in per cent. of a perfect vacuum, etc.

In this country the standard generally accepted is vacuum in inches of mercury referred to a 30-inch barometer. Ordinary steam tables, however, do not give pressures in vacuums, and there is no generally accepted standard of the properties of steam at say 28 or 28.5 or 29 inches vacuum, or of just exactly what pressure is represented by any given vacuum referred to a 30-inch barometer. It was with these points in mind that the publication, "Steam Tables for Condenser Work," just issued by the Wheeler Condenser & Engineering Co., of Carteret, N. J., has been prepared.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

The meaning of the terms "vacuum referred to a 30-inch mean barometer" is clearly indicated, and it is then shown that in expressing pressure in these terms, the temperature of the mercury is assumed at 58.4 deg. F., whereas when atmospheric pressure is expressed in terms of a barometer of 29.92 inches, the temperature of the mercury is assumed as 32 deg. F. Following this discussion, three steam tables are given. In the first, the independent variable is vacuum, and the properties of saturated steam are given from 29.8 vacuum up to atmospheric pressure.

In table 2 the properties of steam below atmospheric pressure are given from 32 degs. F. to 212 degs. F., the temperature being the independent variable accompanied by the pressure expressed in vacuum in inches of mercury referred to a 30 inch barometer and also expressed in pounds per square inch and inches of mercury absolute pressure together with other properties of steam.

Table 3 gives the properties of saturated steam from zero to 200 pounds gauge, the independent variable being gauge pressure instead of absolute pressure, as usually given. The properties of steam may be read off, for instance, at a gauge pressure of 175 pounds without subtraction of 14.7 pounds from absolute pressures and without interpolation.

Following these steam tables, several pages are devoted to a discussion of the principle of the Mercury column and barometer, diagrams being given to show how a U tube is used to measure pressures above atmosphere and below atmosphere and how a closed tube inverted in a reservoir of mercury measures the pressures of the atmosphere. A section is then devoted to a discussion of the correction of vacuum column and barometer readings. The correction for thermal expansion of the mercury is discussed first, a formula being given for correcting the height of a column of mercury at any observed temperature, to the desired standard temperature.

In order to facilitate such corrections, a chart is also given, from which the correction to be added or subtracted from the barometer or vacuum gauge is obtained directly. The remaining pages discuss the corrections for relative expansion of scale mercury, for effect of altitude and latitude on standard gravity (and therefore the weight and pressure of the mercury) and finally the correction for capillarity.

This hand-book which represents a considerable expenditure in time and money is published by the Wheeler Condenser & Engineering Co., Carteret, N.J., primarily for the assistance of engineers using and purchasing condensers and condensing apparatus, to whom it will be sent upon request. Copies are not for sale or general distribution.

TABLE I. IN PART.

Vacuum in inches of mercury referred to a 30-in. barometer mercury at 58.4 deg. F.	Temperature Fahr. t	Specific volume cu. ft. per lb. v	Heat of the liquid H	Total heat of steam H	Entropy of water n	Entropy of steam N
29.3	68.33	918	36.40	1089.6	0.0713	2.0662
29.2	72.27	810	40.32	1091.3	0.0788	2.0548
29.1	75.84	724	43.88	1092.9	0.0855	2.0447
29.1	79.07	657	47.11	1094.3	0.0913	2.0358
28.9	81.97	599.3	50.00	1095.6	0.0968	2.0275
28.8	84.61	552.5	52.63	1096.8	0.1016	2.0203

533 Boiler Explosions in the United States for the Year 1910, causing the death of TWO HUNDRED and EIGHTY PERSONS and the maiming of FIVE HUNDRED and SEVENTY-SIX. Every one of these explosions could have been prevented and the lives of those people saved had proper precaution been taken. SIXTY-FIVE PER CENT. of these explosions were DIRECTLY TRACED TO BOILER SCALE. Can you afford to take the risk of a similar experience? Put a **LIBERTY CLEANER** on the job, remove the danger, cut your fuel expenses in two, and relieve your mind of worry.

SEND FOR OUR CATALOGUE TO-DAY.

LIBERTY MANUFACTURING CO.

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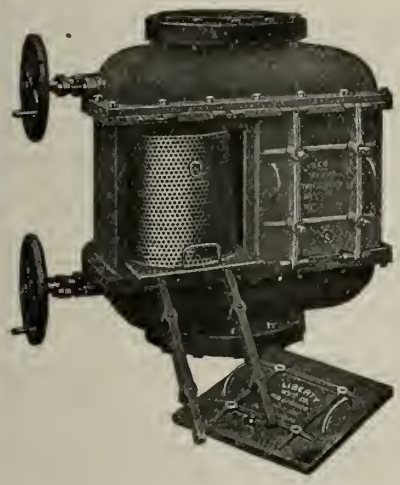


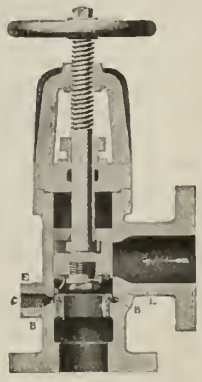
HIGH WATER IS COMING

The Rivers and Lakes from which you get your water supply will soon be filled with all kinds of rubbish. This rubbish will enter your plant, damage your equipment and be the direct cause of expensive shutdowns.

A TWIN STRAINER in the suction line will catch ice, sticks, leaves, fish, etc., prevent them from entering your plant, and thereby save you untold losses.

The Twin Strainer is so constructed that one side can be easily and quickly cleaned while the other side is in operation.

The Twin can be located inside or outside the building—wherever it is most desirable.



Water fluctuations rob a boiler of its efficiency. Wide or sudden fluctuations are responsible for the majority of boiler accidents.

Our FEED WATER REGULATOR maintains a practically constant water level at all times. It is the best assurance against accidents.

Our Regulator is designed and constructed for the most severe and constant service. It has distinctive features which make it superior to all others. All parts are subjected to a thorough test before leaving our works.

Water is separated from steam by sharply changing the direction of flow.

Water may be eliminated from steam at some point of passage within the body of a Separator. It does not follow that steam is leaving that Separator in a dry state.

A Separator must deliver Dry Steam to be effective. It must be constructed to remove the water and prevent that water being entrained by the steam passing through it.

In addition to the baffles required to remove water from steam, **Our Separators** have special baffles or grids which make it impossible for water to be entrained by the steam after it has once been separated therefrom. This makes them superior to others.

If yours are not of this superior type, it will pay you to learn all about **Our Separators.**

ELLIOTT COMPANY

6902 SUSQUEHANNA STREET - - PITTSBURG, PA.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

Duncan.—A company to supply Duncan with electric light and power is being formed. The promoters expect to have the town lighted by electricity before next autumn.

ALBERTA.

Calgary—Tenders for electric machinery consistiug of: One 2,500 k.w. turbo generator, one 1,000 k.w. synchronous motor generator, one 50 k.w. motor driven exciter, one 25 k.w. motor driven exciter. All delivered and erected in Calgary, will be received until March 15th, 1912. J. M. Miller, city clerk.

SASKATCHEWAN.

Saskatoon.—Sealed teuders, addressed to the City Commissioners, and endorsed, "Tender for Electrical Machinery," will he received up to 12 o'clock noon on Friday, March 8, 1912, for the following apparatus:—
5-500 B.H.P. Water Tube Boilers; 5 sets of Automatic Stokers; Induced Draft Plaut and Duplicate Fans for same; Economizers for 2,000 H.P. capacity; 2 Feed Pumps; All necessary equipment for the above. 1-2,000 K.W. High Pressure Steam Turbine, with Condenser, Air Pumps and necessary equipment; 2-75 K.W. Turbine Exciters; 1 Generator Panel; 2 Exeiter Panels; with all necessary cables and apparatus from turbine to switchboard. Instructions to bidders and forms of tender will be furnished on application. The lowest or any tender not necessarily accepted. Jas. Clinkskill, W. B. Neil, E. M. Snell, City Commissioners.

Prince Albert—The committee in charge of the municipal power plant recommended that a supply of motors be purchased for renting purposes. F. A. Creighton, city engineer.

Saskatoon.—The superintendent of the civic power plant, H. G. Sangster, has been notified that the council approve of the calling of tenders for the following plant: Five hundred horsepower water tube boilers with automatic stokers, economizers and independent draught appurtenances, a 2,000 k.w. high pressure steam turbine with generator, condensers, air pump, exciters, and all the necessary equipment for a complete plant. The machinery, which will be placed in the power house, will cost $175,000.

North Battleford.—Engineers Chipman & Powers, Toronto and Winnipeg, have been appointed to prepare plans for the enlargement of the electric lighting plant here.

MANITOBA.

Portage la Prairie.—The waterworks plant and the city electrical plant may be combined. Estimated cost, $10,000. Nothing definite decided until the contract to take power from the Great Falls Power Company, of Winnipeg, is settled. Mayor, J. J. Garland; City Clerk, F. W. Clayton.

The Great Falls Power Co., of Winnipeg, C. Chamberlain, engineer, will build a transmission line from Winnipeg to Portage la Prairie, if the town will contract for 1,000 h.p. for 30 years. The company will buy power from the Winnipeg plant, transmitted at 60,000 volts and stepped down to 2,300 volts. Line to he ready for operation by August 1st.

ONTARIO.

Smith's Falls.—The Smith's Falls Electric Light and Power Company have just installed a new auxiliary steam power plant of the most modern type. The engine, built by The Goldie & McCulloch Co., Galt, Ont., is one of the largest of its kind in Canada and with this valuable addition to their machinery, the superintendents, Messrs. Fraser and Henderson, expect to have a most effective service hereafter. To house the new equipment the company has remodelled its power plant and practically remade it, building a new boiler house at the south. To mark the occasion a banquet was given by Mr. Alex. Fraser, one of the superintendents, at his home, the guests including the President, Mr. W. H. Frost, the stockholders and a few friends.

Brampton.—The town contemplates installing motors for driving turbine pumps for use with Hydro power. Waterworks Commissioner, Dr. G. Roberts, Brampton. J. Beck, Chairman Hydro-electric Commission.

Hamilton.—Engineer E. I. Sifton, City Hall, has been iustructed by the Hydro-electric Department to prepare specifications for the year's supply of meters and transformers. Tenders to be called shortly.

Niagara Falls.—It is reported that with the view to meeting the increased demand for power, the Electrical Development Co. is about to commence extensive additions to its power house and equipment. The large power house is to be extended to the south, the addition to be erected costing over $200,000. Four more units are to be installed, increasing the power development from 80,000 to 120,000 horse power, and the transmission line to Toronto will likely be duplicated. Altogether a sum of about $1,000,000 will be spent by the Electrical Development Co. on the contemplated improvements.

Toronto—The estimates of the works department as prepared by the city engineer, total $2,519,630 for this year, and include $1,460,522 for the waterworks branch. The sum of $350,000 is allowed for two new 15-million gallon pumping engines, $100,000 is to be spent on a 20-inch high-pressure main under the railway tracks on John Street aud up to Queen Street, while $50,000 is provided for filtration plaut maintenance. Large amounts are included also for new mains.

Hamilton—Tenders will be received until February 28th, 1912, for the supply and delivery of 2,200 lineal feet of 48-inch steel intake pipe with expansion joints, intake and flanged specials, sluice valves, bolts and gaskets. Plans and specifications can be obtained from A. F. Macallum, city engineer, city hall, Hamilton. S. H. Kent, city clerk.

QUEBEC.

Verdun.—The municipal council are considering plans for the extension of the municipal water system and the filtration plant. H. Hadley, Jr., engineer.

Quebec.—A coutract for ten years has been given by City of Labrador Electric Company for electric lighting. A Hydro-electric plant aud steam auxiliary will be completely equipped.

St. Pacome.—The River Ouelle Pulp and Lumber Co. wish to get in touch with a manufacturer who can furnish a lighting plant for logging camps which they intend locating where water power is not available. A plant generating electricity and one which can be run without the services of a competent engineer on a storage battery is desired. W. Gerard Power, manager aud secretary, St. Pacome.

Magog.—Messrs. Buzzell Bros. are hustling the installation of a new power plant for their shop on Merry Street. A 40 h.p. outfit is being put in.

Montreal.—The Cedar Rapids Power syndicate, headed by D. Lorne McGibbon, has now assumed the name of the Cedar Rapids Manufacturing Power Co., with Mr. Henry Holgate, C.E., as its provisional president and engineer. The annouucement was made, however, that within a short time, a permanent board of directors would be elected with Mr. McGibbon occupying the presidency. Detailed plans of the company's coming operatious on the north side of the St. Lawrence are so far advanced that tenders will probably be called for the dyke and power house without much delay. The capital of the Cedar Rapids Manufacturing and Power Co. has been definitely placed at $10,000,000, although not more than 50 per cent. will be issued at the present time. There will be an immediate bond issue of $5,000,000, and although the issue has not yet been placed, a statement was made that negotiations have so far advanced that the proceeds of the million dollar bond issue can be in the hands of the company by the time active operations of construction are entered upon.

NEW BRUNSWICK.

Fredericton.—An informal meeting of the Street Light Committee and several members of the City Council was held in the Mayor's Office recently. Mr. Charles Bradley, boiler maker, of the Fleming Foundry, St. John, who was sent here by the insurance company which holds the insurance on the boilers, was present and also Superintendent Walter Carr. Mr. Bradley stated that the boilers were in a very bad state and that the largest boiler should have a new foundation, as it had sunk down several iuches, but he thought that with some repairing and a little work the boilers would be all right again.

THE VILTER MFG. CO., MILWAUKEE.

From a small beginning, in the year 1867, the plant of **The Vilter Mfg. Co.** has grown to be one of the foremost in its line, its principal manufacture being Ice-making aud Refrigerating Machinery which it builds of every capacity in either the vertical or horizontal type. The company also builds a complete line of Corliss Engiues and apparatus for Brewers and Bottlers, and its products are in use in all parts of the world. We give herewith a partial list:

Strathcona, Alberta—The Strathcona Brewing & Malting Co., 40-ton Refrigerating Machine and 14x30 in. Corliss Engiue.

Rossland, British Columbia—Lion Brewing Co., 8-ton Refrigerating Machine.

Victoria, British Columbia—Victoria Phoenix Brewing Co., 25-ton Refrigerating Machine and 14x30 in. Corliss engine; Victoria Arena Co., Ltd., two 75-ton Refrigerating Machines; Vancouver Arena Co., Ltd., Vancouver, B.C., two 75-ton Refrigerating Machines.

Winnipeg, Manitoba—Edelweiss Brewery, 15-ton Refrigerating Machine; Winnipeg Fish Co., 25-ton Refrigerating Machine.

Hamilton, Ontario—F. W. Fearman Co., Ltd., 40-ton Refrigerating Machine and 16x30 in. Corliss Engine.

Ingersoll, Ontario—Ingersoll Packing Co., two 75-ton Refrigerating Machines aud two 22x42 in. Corliss Engines.

London, Ontario—Canadian Packing Co., 35-ton Refrigerating Machine and 14x36 in. Corliss Engine; London Machine Tool Co., 13x26 x32 cross compound Corliss Engine.

Rat Portage, Ontario—Rat Portage Lumber Co., 30x48 in. Corliss Engine.

Windsor, Ontario—British-American Brewing Co., 35-ton Refrigerating Machine and 14x36 in. Corliss Engine.

Saskatoon, Sask.—Hoeschen, Wentzler Brg. Co., 35-ton Refrigerating Machine and 14x36 in. Corliss Engine; 30-ton Refrigerating Machine and 10x30 in. Corliss Engine.

TRADE GOSSIP.

A. H. Winter Joyner, Ltd., 76 Bay St., Toronto, report having had a good year in 1911, and state that the prospects for 1912 are excellent. They hold the sole Canadian agency for the Helios Mfg. Co., Philadelphia, Pa., and have recently completed an installation of the latter company's flame arc lamps (25 cycle) at the Western Cattle Market, Toronto, where they are giving excellent satisfaction. The firm are also representatives for the Pemco street lighting fixtures and at present have a contract on hand for installing the same at Berlin, Ont. Other firms represented by the A. H. Winter Joyner, Ltd., are the Western Electric Instrument Co., Newark, N.J., whose instruments the Toronto Hydro-Electric use exclusively, and the Bristol Co., Waterbury, Conn., the well-known makers of pyrometers and recording instruments of all kinds.

CATALOGUES RECEIVED.

The Pawling & Harnischfeger Co., Milwaukee, Wis., have sent us a new folder showing several illustrations of "P & H" apparatus for steel mill and foundry service. These include charging machines, grab buckets, traveling cranes, I-beam trolleys, mono-rail systems, etc.

The Armstrong Manufacturing Co., Bridgeport, Conn., have just issued a new half-tone 6x9 in. catalogue showing their full line of pipe threading machines and parts. Each part is either lettered or numbered, so that a customer can expeditiously order repairs to replace broken or worn parts and save time, which is very important in case of a breakdown. The No. 0 and No. 00 machines are equipped with the genuine Armstrong Adjustable Dies which are so well and favorably known. The No. 1, No. 1½ and No. 3 machines have bits for threading which are made with the same care and under the same supervision as all other goods manufactured by this concern. The catalogue will be mailed gratis upon request to all interested.

The Best Mfg. Co., Pittsburg, Pa., have forwarded a copy of their 1912 complete catalogue, No. 103, showing a complete line of valves, fittings, flanges, separators, beuds, tees and piping material generally for steam, air or hydraulic high pressure piping systems. The book is of handy size, 6½x4 inches, and is strongly bound in cloth.

John Moncrieff

PERTH, SCOTLAND

Manufacturer of the celebrated

"UNIFIC"

GAUGE GLASSES

These Glasses do not corrode or become encrusted even at very high steam pressures and withstand sudden and extreme variations of temperature.

CATALOGUES and full information of any of these and our other specialties can be obtained from our Canadian Representative

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Write for Catalogue

Power Transmission Equipment and Machinery

MECHANICAL MATERIAL CONVEYORS, INDUSTRIAL RAILWAYS.
Including Rails, Switches, Frogs, Cars, etc.,

———FOR———

MILLS, FACTORIES, MINES, GRAIN ELEVATORS

We carry in Stock a complete line of Transmission Equipment as below.

Iron Pulleys,
Solid and Split
Sprockets,
Bearings,
Gears—Spur, Bevel, Mitre,
Shafting,
Couplings,
Post Hangers,
Post Boxes,
Take-up Boxes,
Boots,
Boot Pans,
Shaft Hangers,
Friction Clutches,
Belting,
Belt Tighteners,
Buckets,
Sprocket Chain Attachments,
Car Movers and Pullers,
Iron Work for Dumps,
Spiral Conveyors.

Equipment and Supplies for 50 Grain Elevators carried in stock at all times.
SEND US YOUR SPECIFICATIONS.

THE MANITOBA BRIDGE AND IRON WORKS, LIMITED

WINNIPEG, MAN.

You Must Use Your Brains

It is probable that no belt will ever be designed that will be universal in its application. There are lots of Foremen in Machine Shops, Foundries and other Plants who fondly believe that they will find the one type of belt which they can use to advantage in every drive in their plant.

We make the assertion, and we are backed up by nearly every man of wide experience in the country, that no one belt is good for universal use.

On your Machine Drives, where you are constantly using belt shifters, leather belts of one grade or another are undoubtedly the best, but supposing you have a drive that is constantly wet and dry alternately, what then? You want a belt that will not shrink or stretch—you want a belt that is strong—you want a belt that will grip—and perhaps you want one that can be made endless. "LANCO" Genuine Balata Belting will answer this purpose better than anything else here.

On your Open or Crossed Drives, whether Main or Small, we can give you a belt in our SCANDINAVIA that will save you money on both your first cost, and your maintenance cost. Leather would do for these drives, but in SCANDINAVIA you will get a belt that will give you more service than leather.

We cannot take up enough space here to tell you about belts, but we will be only too pleased to send you our new booklet called "The Main Drive," on application.

Federal Engineering & Supplies, Limited

Head Office, 284 Yonge St., TORONTO Branch Office, 329 St. James St., MONTREAL

Eugene F. Phillips Electrical Works, Limited

MONTREAL CANADA

Bare and Insulated Electric Wire

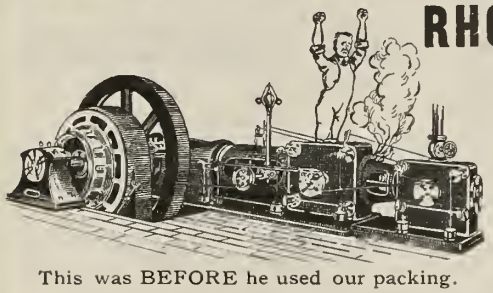
Electric Light Line Wire. Incandescent or Flexible Cords.

Railway Feeder and Trolley Wire

Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.

HALIFAX TORONTO WINNIPEG VANCOUVER

RHODES IMPROVED METALLIC PACKING

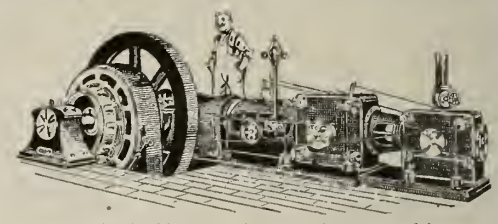


This was BEFORE he used our packing.

THE PACKING THAT PACKS

A trial will convince you.

Beware of Imitations.



This is AFTER he installed our packing.

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited

55 St. Francois Xavier Street, - - - MONTREAL

WALKER'S ELECTRIC BOILER COMPOUND

WILL REDUCE FUEL EXPENSES

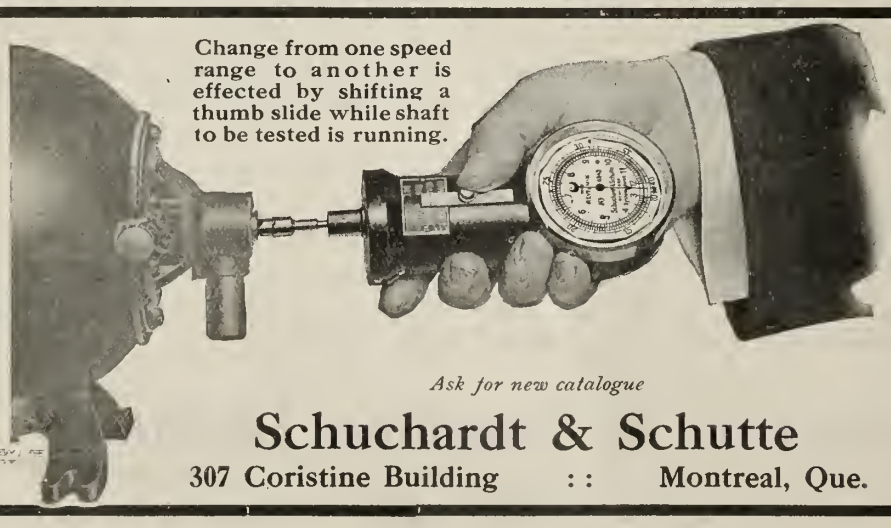
It is a compound that is prepared on purely scientific principles. It is composed of ingredients that work with certainty on all scale and scale-forming matter, and is guaranteed not to injure the boiler in the slightest.

WALKER'S Compound keeps the tubes absolutely clean, thus permitting the boiler to absorb all heat that the minimum amount of fuel produces.

Ask any engineer who knows. He will convince you that there is none better. Write us for list of users. Send us a sample of feed water for analysis, and we will quote you prices on a compound especially prepared for your plant.

The Electric Boiler Compound Co., Ltd.

Guelph, Ontario



Change from one speed range to another is effected by shifting a thumb slide while shaft to be tested is running.

Ask for new catalogue

Schuchardt & Schutte

307 Coristine Building : : Montreal, Que.

ONE SPINDLE FOR ALL SPEEDS

S & S Tachometers

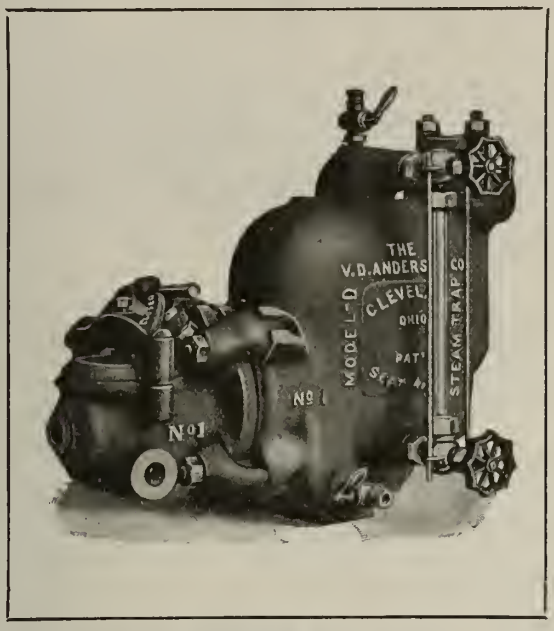
Are the simplest, most efficient measuring devices, universally applicable for rotation and progressive speed.

They give an accurate, independent reading—no watch required—and instantly record the slightest speed variation on both right and left hand motions.

Sizes and styles for all requirements

SEND FOR CATALOGUE.

The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

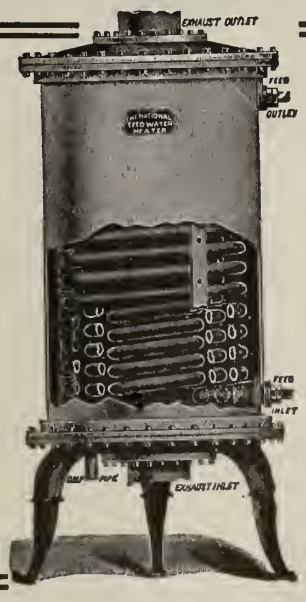
THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

THE NATIONAL
Feed Water Heater

Will make an economical use of your exhaust steam

EVERY engineer who does not use the exhaust steam to heat the feed water to a boiling point before it enters the boiler, is losing money by consuming extra fuel for that purpose.

A small saving means a step towards success, but the saving incurred through the use of this system means a wonderful stride in that direction.



Practical, Very Simple and Highly Efficient

THE feed water comes in contact with the shell, and at no time is the shell subject to boiler pressure, consequently corrosion or leakages are impossible,

The "NATIONAL" is not an experiment, but a heater that has been time tried and thoroughly tested, and guaranteed right in every respect.

Get our Catalog and Prices to-day.

The National Pipe Bending Co.

91 Lloyd Street
NEW HAVEN CONN. - U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

Would you like to Spend your Sundays at Home?

Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

YOU can reduce the labor and expense of boiler cleaning and cut down your consumption of fuel by using

McCOLL'S Special Boiler Compounds

or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

WRITE FOR PARTICULARS TO

McCOLL BROS. & COMPANY

Montreal, Toronto, Winnipeg or Vancouver

FUEL ECONOMY and HIGHER BOILER EFFICIENCY

is always the result from using

Dearborn Feed Water Treatment

No matter how badly scaled the boilers may be, DEARBORN TREATMENT will clean them out and keep them clean.

Clean boilers consume only a minimum amount of fuel. Scale plays havoc with the tubes, and greatly lessens the efficiency and durability of the boiler.

DEARBORN TREATMENT, by keeping the boilers free from scale, and killing all other injurious substances in the feed water, enables the boilers to perform their function at a great saving in fuel costs.

Send us a gallon of feed water for analysis, and we will prepare a compound to suit your feed water conditions.

Let us hear from you NOW.

Dearborn Drug and Chemical Works

General Offices and Laboratory
CHICAGO

Eastern Offices
299 Broadway, ***NEW YORK***

The advertiser would like to know where you saw his advertisement—tell him.

BOILER ENAMEL

is a guaranteed preventative of boiler scale, pitting, corrosion, priming, foaming, etc., which will work equally well in any class of feed water.

"ECLIPSE" is made entirely from tropical plants, and in the process of manufacture no chemicals of any kind are added. It is chemicals that prove disastrous to many boilers and their fittings.

Being harmless, it is slow in its action on old scale, but is deadly sure.

The cost of using "ECLIPSE" in your boilers cannot be compared with the great saving that results from its use.

PROFIT BY THE EXPERIENCE OF OTHERS by writing us for testimonials from many well-known firms in Canada who use this boiler enamel. Their verdict will convince you that "ECLIPSE" will save money.

We guarantee satisfaction, or money refunded.

It's a paying proposition. Write us at once.

W. W. CARRUTHERS

388 Edmonton Street, WINNIPEG, Man.

AGENTS:

J. A. Cartwright, 616 Wellington Street, London, Ont.
A. J. Chamberlain, 52 Colborne Street, Toronto, Ont.
J. H. Elliott, 42 Fort Street, Montreal
W. L. Magee, Middleton, N.S.

"Stick to the Solid Stick"

Don't bother with a smeary liquid or semi-liquid dressing. Don't slow down your belts to apply belt dressing, for you will lose time, power, and money. The best way to keep your belts running fast all the time, and dress them with *Stephenson Bar Belt Dressing.* When you see or hear a belt slipping, simply hold the *Stephenson Stick* to the belt for a few seconds. The slipping stops, and you won't have to bother with that belt for a week or more.

Sure it's easy—and economical, too. *Stephenson* has the advantage of taking effect instantly. There is no waste. No muss. No spattering. Just the thing for *your belts.*

Write for a free half-pound sample.

To enable you to give *Stephenson Dressing* a thorough test, we will send you, absolutely free, a *one-half pound bar* for your own use. Write to-day.

None Genuine Without Our Trade-Mark.

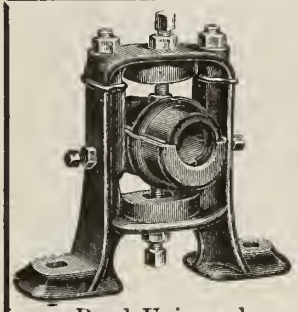
Stephenson Manufacturing Company

Established 1888 — **Albany, N.Y.** — Incorporated 1897

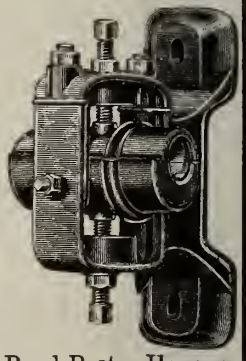
Make Assurance "DOUBLE SURE" and take a "BOND"

All Bearings Babbitted and Reamed

The "Bond" Patent Universal Ring Oiling Ball and Socket Hanger.

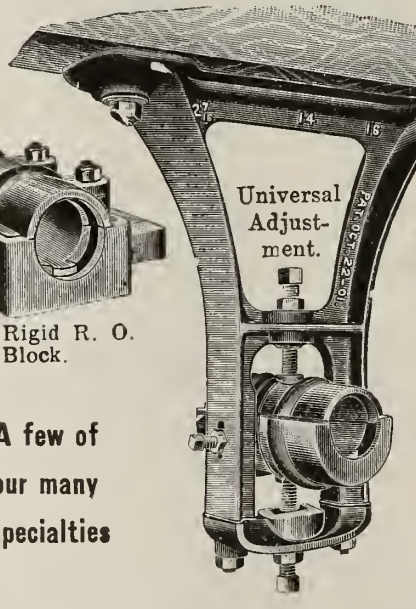


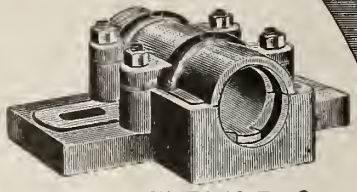
Bond Universal Pillow Block.



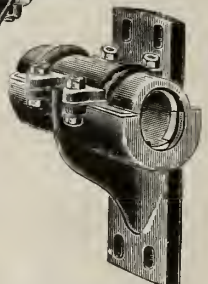
Bond Post Hanger.

SEND US YOUR INQUIRIES



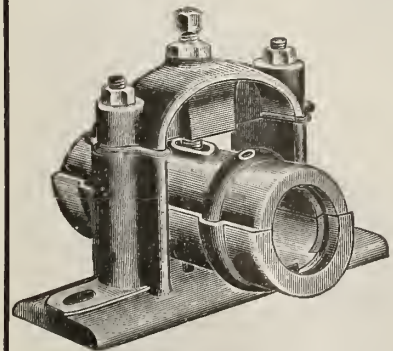


The "Bond" Rigid R. O. Pillow Block.



Bond Rigid R. O. Post Box

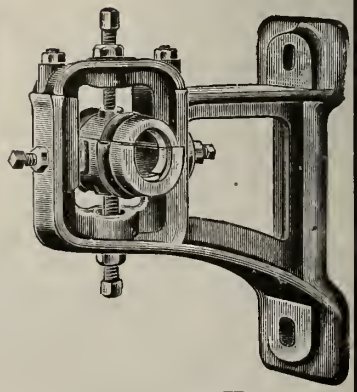
SEND FOR COMPLETE CATALOG "Y"



Bond Pedestal Pillow Block

A few of our many Specialties

A trial order will convince you of its superior merits.



Bond Bracket Hanger

Canadian Bond Hanger & Coupling Co., Ltd.

Manufacturers

ALEXANDRIA - ONTARIO

The advertiser would like to know where you saw his advertisement—tell him.

LOOKING FOR THE "MAPLE LEAF"

is increasingly a habit with those who buy much Belting.

The reason is not hard to find, for there is no part of your Belting system, from the main drive to the smallest light Belt for power transmission, where you will not get the best kinds of service from

"MAPLE LEAF" BRAND
Stitched Cotton Duck Belting

It is the most economical Belting because it is durable under every condition; even where other Belting will deteriorate rapidly. It is water proof.

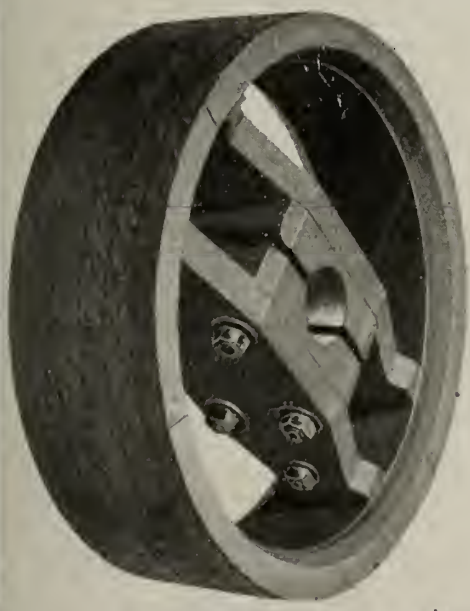
It runs absolutely true on the Pulleys.
It is built of plies of selected duck.

WRITE FOR INFORMATION AND PRICES

DOMINION BELTING CO., Ltd.

HAMILTON, CANADA

A Combination Hard to Beat



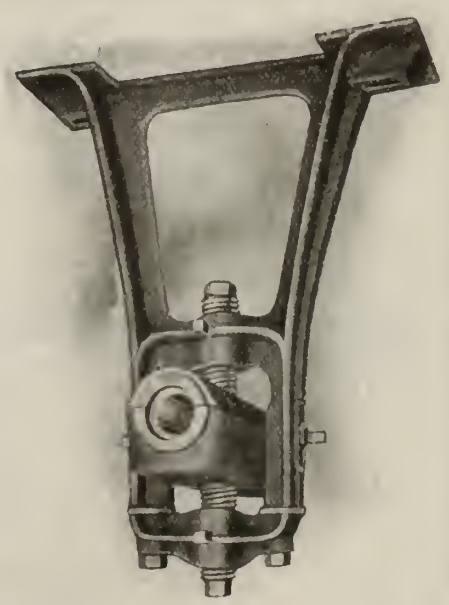
Elmira Ball and Socket Hangers

Elmira Wood Split Pulleys

The Elmira B. & S. Hangers are designed to meet the hardest and most exacting conditions. They are of good weight, correct design, and well proportioned. A Duplex system of oiling is employed consisting of tempered steel rings and woven cotton wick.

The Elmira Pulley is built to stand the hardest service and most severe conditions. The rim is nailed throughout. The arms are tenoned into the rim and dowelled there. The pulley is guaranteed to run wherever a leather belt will give satisfaction.

Send for our Illustrated Catalogue "C."



Large and complete stocks carried at Elmira, and by

The A. M. ELLICOTT CO., 301 St. James Street, Montreal, Que., Sole Eastern Agents.

Elmira Machinery & Transmission Co., Limited - - Elmira, Canada

If You

have a belt drive situated in steam-laden atmosphere or where the belt comes in contact with solid water, such as drips, etc.

"AMPHIBIA"

WATERPROOF

LEATHER BELTING

is the kind to order, so that you may have ***complete satisfaction.***

DO YOU WANT A BELT ON TRIAL?

Write us.

Sadler & Haworth

ESTABLISHED 1876

MONTREAL
511 William Street

TORONTO
27 Melinda Street

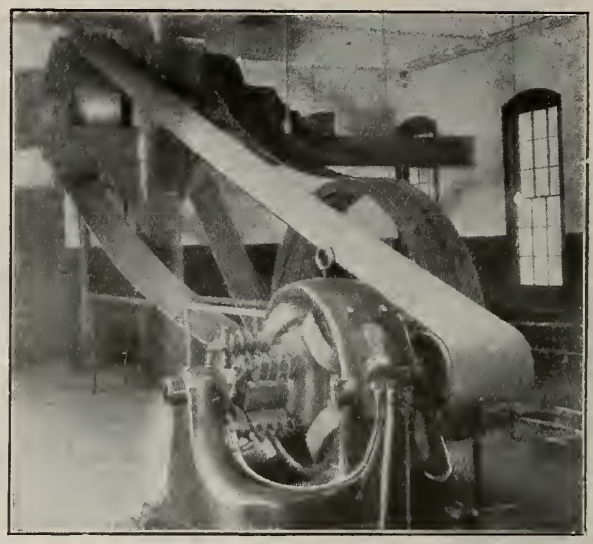
ST. JOHN, N.B.
89 Prince William Street

VANCOUVER
217 Columbia Avenue

WINNIPEG
244 Princess Street

For Over 35 Years the Makers of the Best Belts.

This ***DOES*** make a difference to you.



What Cling-Surface does for these drives.

The American Meter Co., Metric Metal Works, Erie, Pa., have used Cling-Surface continuously FOR 12 YEARS. Their opinion is therefore worth attention. THEY KNOW.

In acknowledging the benefits from Cling-Surface treatment in this plant, the manager, Mr. J. H. Payne, writes us as follows about the belts shown above:

> The belts in our engine room have been doing service for six years or longer, are treated regularly with Cling-Surface and are in perfect condition to-day. We have taken up slack **only once** during their **six years' service** and at no time have these belts given the slightest trouble. Our engineer is quite positive that the intelligent use of Cling-Surface has much to do with the splendid conditions existing."

While this letter speaks for itself, we want to emphasize the slackness of these belts, especially the one with top-pull. In this instance, added slack is a disadvantage rather than otherwise in that the arc of pulley contact is decreased, yet THERE IS NO BELT SLIP. In other words, a belt treated with Cling-Surface does with LESS pulley contact work which such a belt when tightened can't do with INCREASED contact. It's the KIND of contact that counts, so if the soft velvety cling obtainable only with Cling-Surface makes a top-pull belt do such good work and without attention as mentioned above, doesn't it stand to reason that with an under-pull belt, where the conditions are ever so much more favorable to Cling-Surface, the results of Cling-Surface treatment MUST BE even better?

It takes no mechanical expert to appreciate that a belt treated with Cling-Surface and running free from initial tension minimizes journal friction and lubrication, relieves the shafting, hangers and pulleys from excessive strain and so effects a power saving that extends clean back to the coal pile.

You have all to gain, nothing to lose in trying Cling-Surface, for we want no money until you are thoroughly satisfied. Ask for literature and our special offer on a first order.

Cling-Surface Co

1057 Niagara Street - Buffalo N Y

LEVIATHAN

HIGH QUALITY BELTING

Main Drives a Specialty

BELTING SERVICE

Here is the "Why"

CUT THIS OUT

Leviathan Belting is scientifically conceived and made. By that we mean it is made to *effectively meet requirements.*

These are they:

First, traction: Leviathan is coated and impregnated with a preparation which gives tremendous traction and makes it possible to deliver the power with a "slacker" belt than is feasible with other makes or kinds. Second, durability: It is so treated that constant wear and tear has the minimum effect upon it. Third, proof against adverse surroundings: It is so treated that its environment—whether hot or cold water, steam and many gases—will not affect it. Fourth, proof against stretching: Canvas in long lengths, specially made and carefully folded and stitched, so treated by our exclusive process that the maximum amount of stretch is eliminated.

What is the result? A *dependable*, long wearing, efficient belting, low in initial cost and wonderfully low in the "long run" cost.

We have a little book telling about it. Fill in your name and address, and we will mail it to you. Also write particulars of any belt you want.

Main Belting Company of Canada, Limited

41 Common Street, MONTREAL

20 Wellington St. West, TORONTO

WE REQUIRE A BELT FOR TRANSMISSION

and will wish delivery about.....
Size of belt.....' long by.....'' wide.
Dia. Driving Pulley.....
Dia. Driven Pulley.....
Approximate H.P.....
Revolutions of Driving Pulley.....

If the belt is used crossed, at quarter turn, with idler, or subject to any unusual conditions, including extreme heat, moisture, gas or oil, we state below.

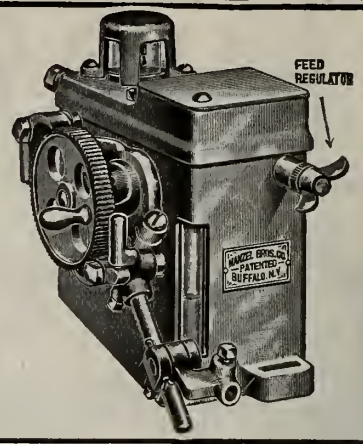
.....

Name.....

Address.....

The advertiser would like to know where you saw his advertisement—tell him.

Let Us Send You a Manzel Oil Saving Oil Pump on Thirty Days' Trial



30% OIL SAVING GUARANTEED

You may be able to save as high as 60%. Many others have done so. The "Manzel" New Model Oil Saving Oil Pump is a positive lubricator. It oils the cylinders right all the time, and makes a big reduction in oil bills, besides saving labor and wear and tear on the engine.

You can try a "Manzel" Pump with the distinct understanding that it may be returned at our expense if it doesn't reduce your oil bills at least 30%.

Send for one on these conditions. Catalogue on request.

MANZEL PUMPS are carried in stock by

THE TWIN CITY OIL CO.
General Agents Ontario and Quebec
Berlin, Ontario.

BAYFIELD & ARCHIBALD
General Agents for the Northwest.
Molsons Bank Bldg., Vancouver, B.C.

Write to either of the above firms for catalog and full information. MANZEL BROTHERS CO., Buffalo, N.Y.

When All Others Fail

GERMAN VALVE CYLINDER OIL,
GERMAN ENGINE OIL.
STERLING FAST ENGINE AND DYNAMO OIL,
STERLING FRICTIONLESS COMPOUND
will cure your troubles.

Canadian Oil Companies Limited,
Toronto, Winnipeg, Montreal, St. John, Halifax, Calgary.

YOU WANT TO IMPROVE YOUR POSITION

THEN READ THE

LIFE OF JAMES WATT

INVENTOR OF THE STEAM ENGINE

By ANDREW CARNEGIE

An entertaining book for those interested in mechanics and power, dealing with the scientific and mechanical inventions of Watt's life and times and his relations with other noted scientists and inventors.

The author, as a practical engineer, possesses all the technical knowledge necessary to give actuality to his writing, and his book is alive with enthusiasm and appreciation. He has missed no point in the romance of Watt's career, with its many thrilling episodes and its study of human nature revealed in a realistic manner. Mr. Carnegie may not point out how to become a millionaire, but he certainly sets forth considerations which may help to influence many a working man to improve his position.

Cloth Bound. 164 Pages. Postpaid, $1.00.
OR FREE to subscribers who send in two new subscriptions to Power House.

TECHNICAL BOOK DEPARTMENT
MacLean Publishing Co. - 143-149 University Ave., Toronto

Where High Quality Prevails!

"The choice of every engineer who knows."

The choice, because it adds longer life to machinery and permits better power transmission.

A trial will convince you of its high quality.

Send us your request for a sample to-day.

***C. C. Snowdon,* Wholesale**
P. O. Box 1384* *CALGARY, ALTA.

The advertiser would like to know where you saw his advertisement—tell him.

Does Cold Weather Affect Your Lubrication?

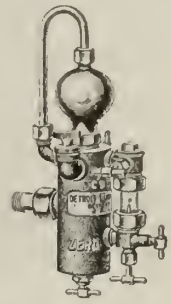
Detroit Lubricators have a heating passage that keeps the oil in a thoroughly liquid condition at all times.

This heating passage extends directly through the body of the lubricator. It is filled with live steam at all times and prevents the oil from getting chilled.

This passage is cast integrally with the body, of which it is a part. The amount of metal and the area of its surface give ample radiation of heat.

Because of the heating passage Detroit Lubricators feed stiff oil in cold weather with ease.

The Detroit Zeros are outdoor lubricators



The Detroit Zeros have the same heating feature which enables them to give efficient and dependable lubrication in every temperature—even the coldest.

They are made for all kinds of service and will withstand the roughest outdoor usage.

There is a Detroit Lubricator for *every* purpose.

Write to-day for catalog G.

DETROIT LUBRICATOR COMPANY.
DETROIT, U.S.A.

Largest manufacturers of lubricating devices in the world.

YOU CAN'T GO WRONG

WHEN YOU SPECIFY

Lunkenheimer Oil and Grease Cups

THEY ARE MADE OF THE HIGHEST GRADE OF MATERIALS AND ARE VERY STRONG, PARTICULARLY IN THE SHANK, THE PART SUBJECTED TO THE GREATEST STRAIN.

JARRING OF THE MACHINERY TO WHICH THEY ARE ATTACHED WILL NOT SHAKE THEM TO PIECES, NOR WILL IT AFFECT THE SETTING OF THE FEED.

ALL CUPS ARE EASILY FILLED AND THE SIGHT-FEEDS ON THE OIL CUPS ARE LARGE, PERMITTING THE OIL TO BE SEEN FROM QUITE A DISTANCE, AND DO NOT EASILY BECOME OIL SPLASHED.

LUNKENHEIMER LINE OF OIL AND GREASE CUPS IS A VERY LARGE AND COMPLETE ONE, AND AMONG THEM CAN READILY BE FOUND A CUP PARTICULARLY ADAPTED TO SUIT ANY REQUIREMENT.

"Most supply houses sell them—yours can—if they dont or wont—tell US."

The Lunkenheimer Company

Largest Manufacturers of High-Grade Engineering Specialties in the World
General Offices and Works: CINCINNATI, OHIO, U.S.A.

CHICAGO	NEW YORK	BOSTON	LONDON, S.E
186 North Dearborn Street	64-68 Fulton Street	138 High Street	35 Great Dover Street

The advertiser would like to know where you saw his advertisement—tell him.

MACHINERY WANTED AND FOR SALE

FOR SALE.

BELTING FOR SALE—800,000 feet of best quality leather, rubber, hair and canvas belting, bought from bankrupt manufacturers at 25% to 75% less than the regular value. Also a large quantity of slightly used belting, piping, chains, rails, pulleys, hangers, cotton waste, etc., at very low prices. Send for catalogue. IMPERIAL BELTING AND SUPPLY CO., 5 Queen Street, Montreal.

WANTED.

LARGE European Concern, manufacturing Water Turbines, Centrifugal Pumps and Steam Turbines, wants to be represented in Winnipeg and Vancouver, by well-known, qualified and experienced firm. Apply Box 111, THE POWER HOUSE, Toronto.

WANTED.

WANTED — Every Power House in Canada to remember that C. E. Shedrick, Craig Street West, Montreal, is still repairing measuring instruments, both switch board and portable. Twenty-five years' experience in repairing all kinds and makes on the market. Integrating meters repaired, tested and sealed, and returned on quick time.

SALESMEN WANTED.

LAKE ERIE BOILER COMPOUND CO. require a few first-class representatives to sell their well-known Compound. Liberal commission paid to live men and exclusive territory. Write at once, giving references, 11 Colborne St., Toronto. (tf)

SITUATION WANTED.

ELECTRICAL ENGINEER, now in charge of operating department of large power company, wants change. Experience with 10,000 v., 3-phase, 50-cycle overhead and underground mains and sub-stations. Box No. 115, THE POWER HOUSE, Toronto.

SALESMAN'S position, experience in Canada and England. Steady and reliable, age 34, engineering or electrical specialty preferred. Highest recommendation. Address, J. SNOWBALL, 1023 Second Avenue, E. Owen Sound, Ont.

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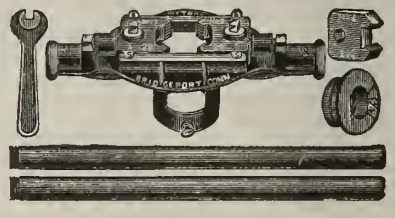

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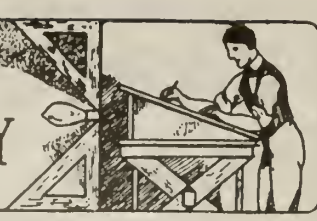

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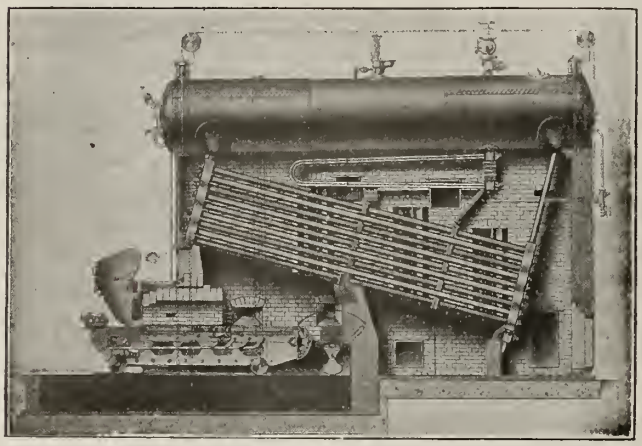

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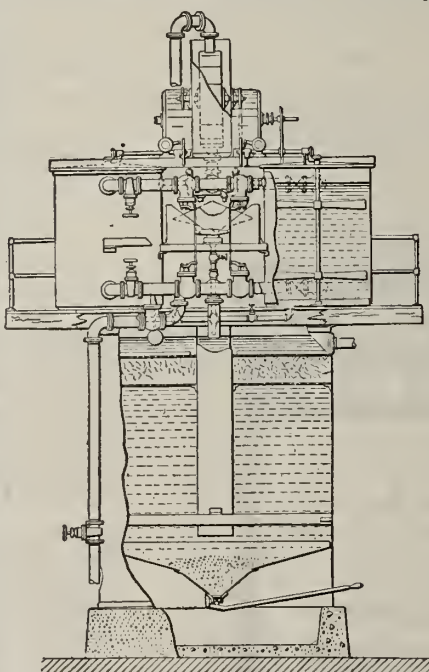

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Waterous Engine Works Co., Brantford

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Jones & Glassco, Montreal

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Jos. Dixon Crucible Co., Jersey City
C. C. Snowdon, Calgary

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Richardson-Phenix Co., Milwaukee, Wis.
Twin City Oil Co., Berlin, Ont.

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Detroit Lubricator Co , Detroit
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, Ohio

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Dunlop Tire & Rubber Goods Co., Toronto
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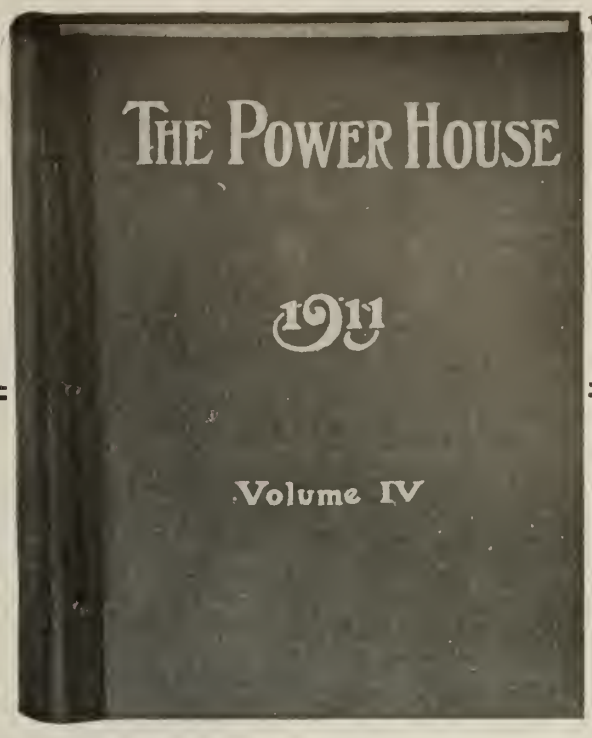

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General Supply Co. of Canada, Ottawa
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Terry Steam Turbine Co., New York
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Deming Co, Salem, O.
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General Machinery Co., Toronto
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Eadie-Douglas, Ltd, Montreal
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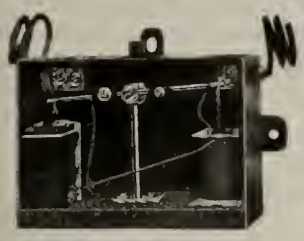

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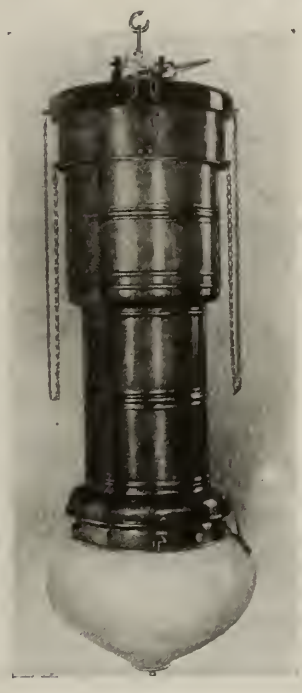

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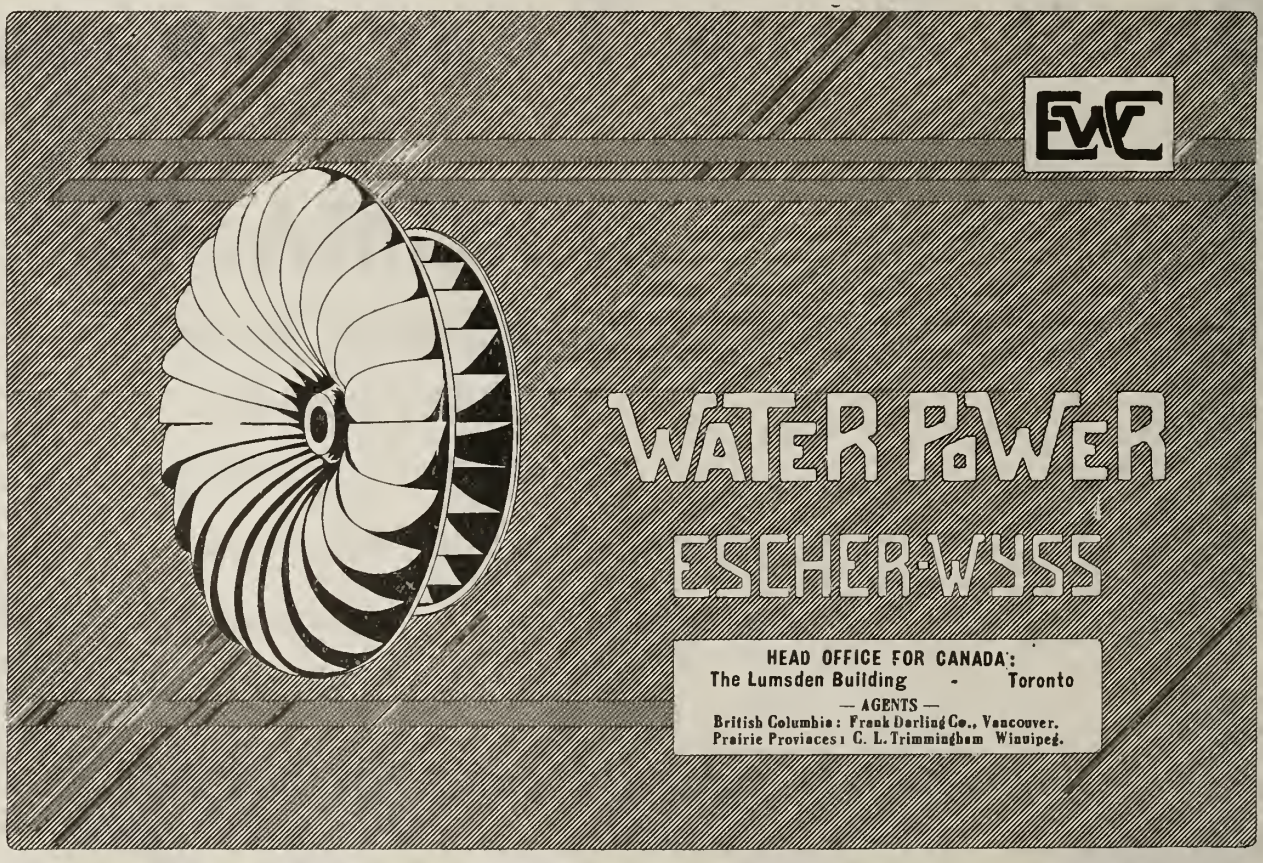

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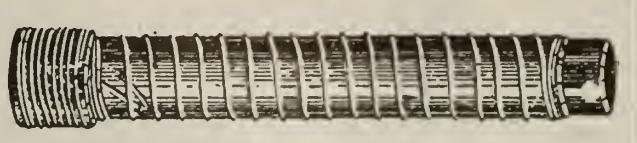

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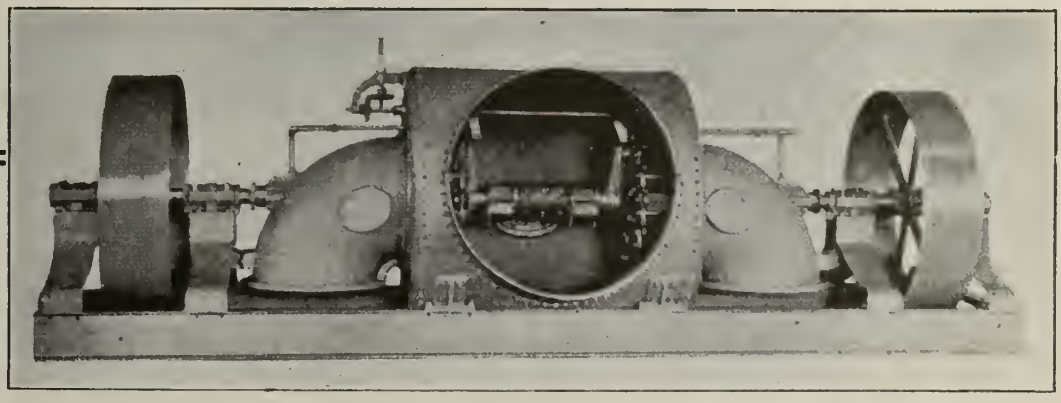

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Protective Apparatus

Electrolytic Lighting Arrester
2200 to 120000 Volts A.C.

Type "S" Arrester
1200 to 7000 Volts A.C.

Type "C" Lightning Arrester
500 to 2500 Volts A.C.

"M.P." Arrester
0-1000 Volts
A.C. or D.C.
Circuits.

There is no such thing as A Universal Lightning Arrester

However, the line of lightning arresters now manufactured by the Canadian Westinghouse Company provides for every possible contingency of service. The different types are suited respectively to varying conditions, local and electrical and, either singly or in combination, provide effective, adequate and reliable protection for systems of any capacity up to 120,000 volts.

We illustrate four of our more popular types, the complete line is described and illustrated in Circular No. 1032. Ask nearest office to mail you a copy.

Canadian Westinghouse Company, Limited
HAMILTON, ONTARIO

TORONTO	MONTREAL	HALIFAX	WINNIPEG	CALGARY	VANCOUVER
Traders Bank Bldg.	52 Victoria Square	Telephone Bldg.	158 Portage Ave. E.	311 8th Ave. W.	Bank of Ottawa Bldg.

When Things Go Wrong

with your steam plant, make it a point to enquire into the merits of Morrison's Steam Specialties.

For years we have been pounding away at the superior quality and reliable performance of our goods, but many manufacturers seldom bother with their steam equipment unless something happens.

We want you to know and realize that—

Morrison's J.M.T. Injectors
Morrison's Steam Gauges
Morrison's Steam Cocks
Morrison's J.M.T. Valves
AND
Morrison's Standard Lines

Hancock Inspirator. Reliable and Efficient.

are an absolute assurance against trouble, being carefully constructed of the best metal and guaranteed for long service. We are specialists in every detail of brass manufacture and have a country-wide reputation for reliability and satisfaction.

J.M.T. Pop Safety Valve, with side outlet. Made in screwed or flanged connection.

The James Morrison Brass Mfg. Co., Limited

93-97 ADELAIDE STREET WEST - - TORONTO

Special Feature —Articles on Refrigeration

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-149 University Ave LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. V. Publication Office, Toronto—March, 1912 No. 3

PENBERTHY TRADE MARK

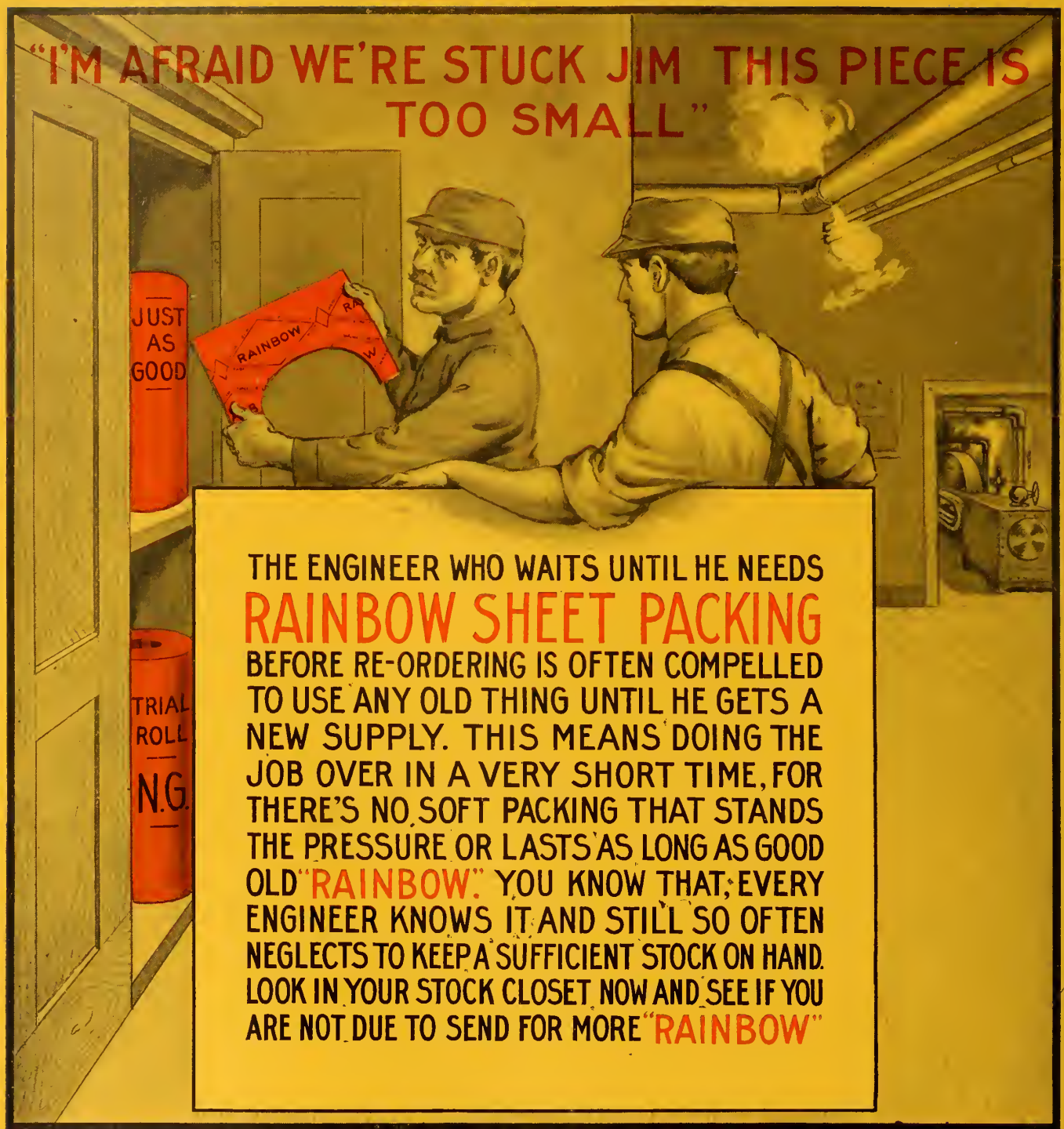
Peerless

PENBERTHY TRADE MARK

A REAL QUALITY LUBRICATOR

MANUFACTURED BY

Penberthy Injector Co., Limited - Windsor, Ontario, Canada



THE ENGINEER WHO WAITS UNTIL HE NEEDS

RAINBOW SHEET PACKING

BEFORE RE-ORDERING IS OFTEN COMPELLED TO USE ANY OLD THING UNTIL HE GETS A NEW SUPPLY. THIS MEANS DOING THE JOB OVER IN A VERY SHORT TIME, FOR THERE'S NO SOFT PACKING THAT STANDS THE PRESSURE OR LASTS AS LONG AS GOOD OLD "RAINBOW." YOU KNOW THAT; EVERY ENGINEER KNOWS IT AND STILL SO OFTEN NEGLECTS TO KEEP A SUFFICIENT STOCK ON HAND. LOOK IN YOUR STOCK CLOSET NOW AND SEE IF YOU ARE NOT DUE TO SEND FOR MORE "RAINBOW"

Manufactured Exclusively by

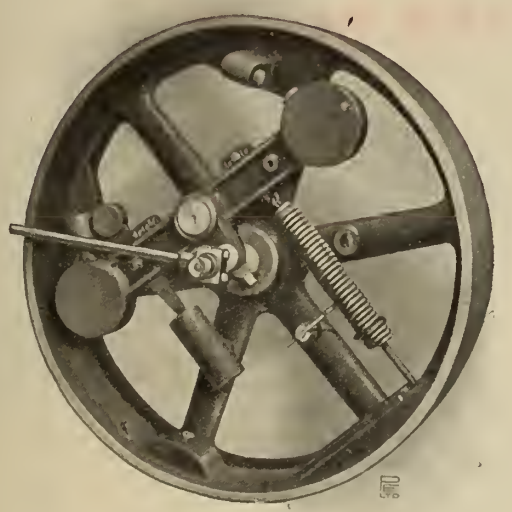
Peerless Rubber Manufacturing Co.

16 Warren Street, NEW YORK

FOR SALE EVERYWHERE

H. D. Edwards & Co. - Canadian Distributers

The McEwen Engine



Why we guarantee its speed regulation

Every McEwen Engine we sell is issued with a rock-bottom guarantee that reduced to plain English means "Perfect engine regulation or your money back."

We have never been asked to redeem this guarantee, although there are hundreds of McEwen Engines operating in Canada to-day. And the Begthrup Inertia Governor is the reason why.

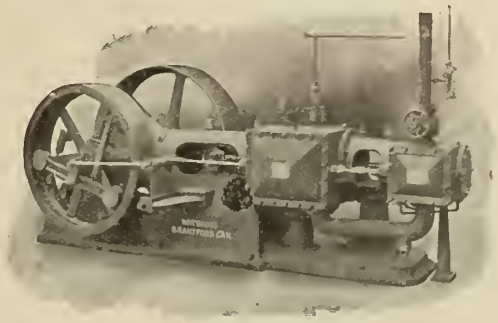
It is simple in construction. It is easy of adjustment.

It can be regulated to speed up under load and still govern perfectly without the least tendency to race.

With it the McEwen Engine can be adjusted to govern within the limit of one revolution. The entire load can be thrown on or off with an instantaneous variation of speed not more than one per cent. The engine will return to its standard speed with but one vibration and within the space of two seconds.

Our Guarantee Read It—

The engine shall not run one revolution slower when running fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work will not reduce the speed of the engine one revolution. Any engine failing to meet this guarantee becomes the property of the purchaser on the payment of one dollar.



This Governor is used only with the McEwen Automatic Engine. Along with the perfect regulation this Governor ensures, the McEwen combines simplicity of design, with exceptional strength and accessibility.

For this reason we recommend it particularly for isolated plant installation. Built in simple and compound types in sizes up to 700 Horse Power.

Write

The Waterous Engine Works Co., Limited

Brantford, Canada

PISTON ROD PACKING

That Ensures BETTER Results

DUNLOP

Dunlop Piston Rod Packing before pressure from the Gland is applied in the Stuffing Box.

Dunlop Piston Rod Packing under pressure, showing how it expands to take up wear from the rod.

This is a packing that cannot be affected by Oils, Alkalis, etc., and always proves to be highly effective in prolonging the life of machinery.

Can be used with Steam, Water, Ammonia, and works equally well on a heavy pump as on the most sensitive valve stems.

It expands so as to take up wear from the rod, which eliminates all possibility of friction.

It is self-lubricating and cannot become hard under any condition.

When in the market for Packing, Belting, Hose, Valves, etc., consult us. We have everything that will meet your requirements and give the greatest satisfaction. We make a suitable article for every specific purpose. If you purchase our line you will be one of the many who realize that fact.

Link yourself up with our "Two Hands" trade-mark—it's your protection.

WRITE AT ONCE FOR FULL PARTICULARS.

DUNLOP TIRE & RUBBER GOODS COMPANY, LIMITED

Head Office and Works: TORONTO

BRANCHES:—Toronto, Montreal, Winnipeg, Vancouver, St. John, N.B., Calgary, Victoria, London, Ont., Regina, Ottawa, Cobalt, Nelson, Hamilton.

LINDSAY TYPE
HIGH PRESSURE PISTON
PACKING.

DANIELS'
P.P.P. ROD PACKING.

"GENSUP" SPIRAL
PACKING.

HIGH GRADE
PACKINGS

Are Always The Most Economical

This has been proved time and time again by the service which our packings have given. We use only the best materials, and spare no efforts to give our trade the utmost value for their money.

We furnish a packing suitable for every requirement, and guarantee it to give long reliable service.

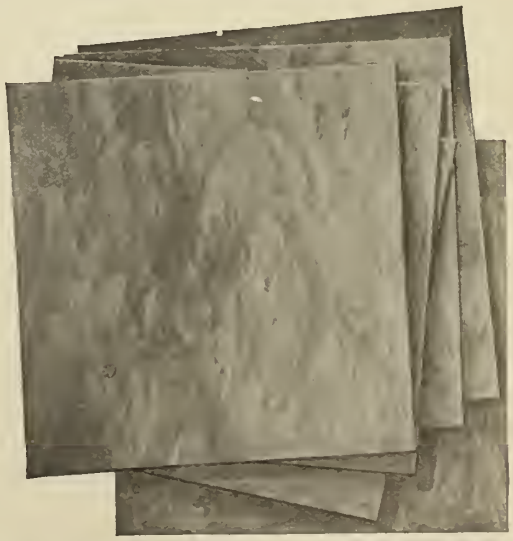
Write for our illustrated catalogue at once. It will give you some valuable information on Packings.

The General Supply Co., of Canada
Limited

WINNIPEG OTTAWA
TORONTO
115-125 ADELAIDE STREET WEST

PEERLESS
SPIRAL PISTON AND
VALVE ROD PACKING.

"GENSUP"
VALVE STEM
TWIST PACKING.



"GENSUP" HIGH PRESSURE JOINTING

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY

Do You Earn Enough to Provide a Home for "Her"?

Whether "the girl" is your wife, or your wife-to-be, you owe it to her to earn all you can. This is the one sure way to make your dreams come true.

We offer you, **FREE**, a little book which has helped many engineers to earn more, and to pass their License Examinations. If you want a copy, fill out and mail the coupon below.

How to get the Hand-book FREE

Fill out the Coupon and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and look at Daniels' P.P.P. Packing.

YOUR NAME. .....
ADDRESS .....
EMPLOYED BY .....
ADDRESS .....
HORSEPOWER OF ENGINE .....
KIND OF ROD PACKING USED .....
DO YOU USE EBONITE SHEET PACKING? .....
WHO BUYS YOUR SUPPLIES? .....
DEALER'S NAME .....
ADDRESS .....
..... Series 24-C

If your dealer doesn't carry P.P.P., we will write telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

Saving Money for the "Boss" Means More Wages for the Engineer

The quickest way to get next to the "boss" is to look out for his pocket book. And let him know it.

We can show you how to prove to the "boss" that you can save $100.00 to $500.00 a year on his coal bill. The "secret" is

Daniels'
P. P. P.
Rod Packing

Ordinary packing exerts a **Maximum** pressure on the rod during the entire piston travel. P.P.P. adjusts the pressure to the requirements, whether it be 200 pounds or but 5 pounds. This saves fully 90 per cent. of unnecessary friction. "The Story of Some Friction Tests" is scientific proof that you can save $100.00 or more a year in coal. Send for a **FREE** copy.

"Regular"

Three Styles: "Regular," "Special," and "Marine." All styles are furnished in Coil, Spiral, and Ring forms.

FREE To Users of P.P.P.

If you are a user of P.P.P., fill out the coupon and mail it us. We will send the Engineers' Examination Book to your dealer (or one we name) who will hand it to you when you call at his store and look at Daniels' EBONITE Sheet Packing.

QUAKER CITY RUBBER COMPANY
Manufacturers of Mechanical Rubber Goods
PHILADELPHIA, PA., U.S.A.

It has been demonstrated repeatedly that Garlock Duo Hydraulic—Style No. 960 (Illustrated Below) will hold a pressure of 3000 pounds.

This packing is a combination of braided copper, metal wedge and waterproof hydraulic rings, being expressly designed and built for use in steel mills, blast furnaces, and railroad shops where the demands on packing are most severe. We make other combination sets, suitable for different requirements in hydraulic work.

A postal card will bring our new 1912 catalog of 112 pages, showing "Packings for every purpose."

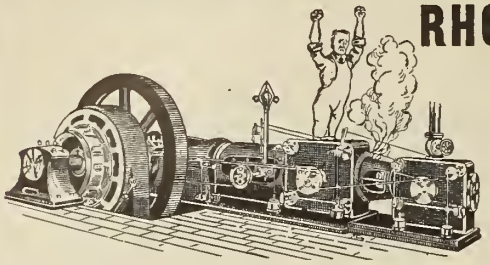
THE GARLOCK PACKING CO.

Head Office and Works, - - - - - HAMILTON, ONT.

PIONEERS IN THE PACKING BUSINESS.

The advertiser would like to know where you saw his advertisement—tell him.

RHODES IMPROVED METALLIC PACKING

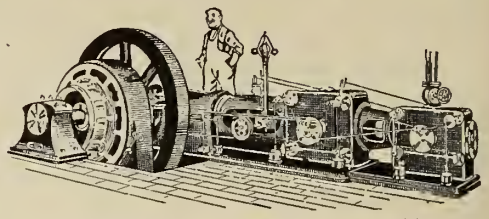


This was BEFORE he used our packing.

THE PACKING THAT PACKS

A trial will convince you.

Beware of Imitations.



This is AFTER he installed our packing.

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited

55 St. Francois Xavier Street, - - - MONTREAL

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

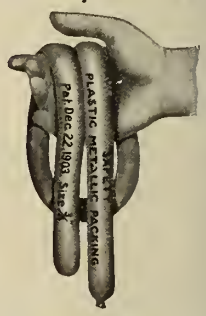
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

Practically Frictionless



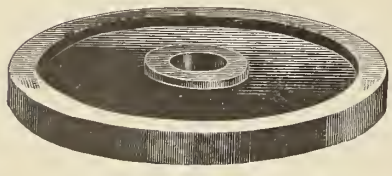
Sold on APPROVAL

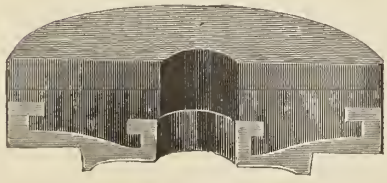
The ASBESTOS & RUBBER GOODS CO.

TORONTO, Ont.
141 King Street East,

MONTREAL, Que.
43 St. Francois Xavier Street,

L. R. & B. PUMP VALVES





Give better service than any other, and last longer

Brass Casing prevents ports from forcing through.

Only best quality of material is used, and as wear takes place the rubber can be replaced until brass casing is reached, thereby giving full use of all the rubber.

It only needs a trial to convince you.

We also carry a full stock of all other engineers' supplies.

Write us before placing your orders.

Stop Wasting 1/3 of Your Boiler Capacity

The amount of steam a boiler develops and the amount of coal it consumes are affected by the amount of scale in the tubes. If your boiler contains 1/8-inch of scale, it means you are *wasting 1/3 its capacity;* that about *1/3 your fuel* is wasted; that with the scale removed, two boilers would do the work of three; that every third shovel of coal put into the boiler is so much energy wasted. There is a *sure* way of removing all old scale from a boiler and preventing the formation of new—the way that hundreds of others are doing it—by the use of J-M Boiler Preservative.

J-M Boiler Preservative *actually does* what others claim to do—not because we say so, but because

J-M Boiler Preservative

works on a new principle. Although a liquid preservative, its action is not chemical, but purely natural.

Iron, under heat, attracts J-M Boiler Preservative like a magnet does steel; the preservative flows over the surface of the iron, coating it in much the same manner as cylinder oil coats the inside of a cylinder.

The preservative is drawn through the cracks in the scale and works its way between the scale and the iron. This action loosens the scale and it drops off. The scale sediment can then be readily blown off or washed out.

After the scale has been once removed, there will be no further formation of scale if J-M Preservative is used according to directions.

Write our nearest Branch for further particulars.

THE CANADIAN H. W. JOHNS-MANVILLE CO., Limited

Manufacturers of Asbestos and Magnesia Products — Asbestos Roofing, Packings, Electrical Supplies, Etc.

TORONTO, ONT. MONTREAL, QUE. WINNIPEG, MAN. 1574 VANCOUVER, B.C.

A STEEL GASKET

For Water Tube Boilers

The (Double R.-R.) Gasket

Made in Canada

We are the Sole Manufacturers in Canada of the Steel Asbestos Gaskets.

Mr. Engineer!

No more plates to clean, there is nothing in a steel gasket to melt or burn, and stick to the plates, just a steel shell filled with an asbestos cord. Cheaper and better than any other Gasket on the market.

Write for free sample, naming the make of boiler

CANADIAN GASKET CO.

BRIDGEBURG, ONTARIO

Corrugated Copper Gaskets of all kinds.

FLEXIBLE INTERLOCKING METAL HOSE

For Conveying Steam, Air, Gas, Etc.

This metal hose is made in either steel or copper and is just as light and flexible as rubber.

It will not kink, burn out or rot, and will give real service under all conditions.

Its lasting qualities are many times greater than those of rubber and there is practically no cost of maintenance.

Our prices are right. Get our circulars NOW.

The Metallschlauch-Syndikat

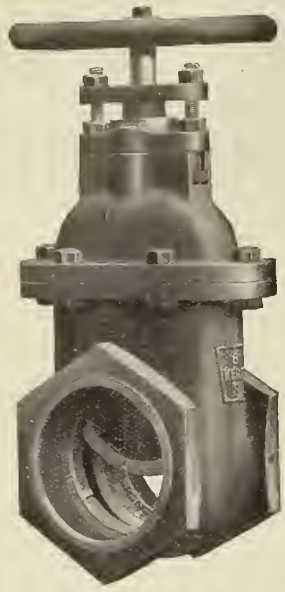
PFORZHEIM, BADEN - GERMANY

F. J. SCHUCH

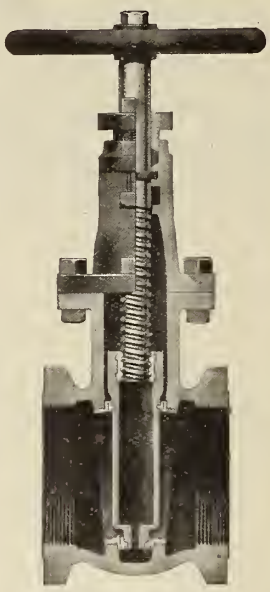
191 Jarvis St. - Toronto, Canada

(Canadian Agent)

The advertiser would like to know where you saw his advertisement—tell him.



6 inch Screwed
Iron Body Gate Valve



6 inch Interior View
of I B B. M Gate Valve.

KERR

IRON BODY
GATE VALVES

The above illustrations are of the new "KEYSTONE" pattern gate valve which we are now shipping to our customers, and which is being so favorably commented upon by all who have as yet seen them, owing to their modern equipment and strong compact design.

See that

KERR

is on the body of the next valves you buy.

Specify them, and you'll get them.

The Kerr Engine Co.
LIMITED
WALKERVILLE - - ONTARIO

Nelson Steel Gate Valves for Superheated Steam

YOU cannot consider Economy through superheated steam without considering *Equipment for Economy's sake.*

Your economy is *greatest* when your Equipment is *best*, running smoothly, constantly, safely—*have you experienced that?*

Or have you found the leaks serious, the shut-downs frequent, and repairs expensive, so that your *Economy Pride* has been supplanted by an *Abnormal Expense Spectre?* We trust you will *never* experience that.

And yet, if you *have* failed to find a valve on which you can, with confidence, impose the severe strains and stresses of superheated steam, then—

Our mission, in this friendly page of POWER HOUSE, is to invite you to look into the merits of the Nelson Steel Gate Valve for superheated steam—*for Economy's Sake!*

We would have you investigate it thoroughly from every standpoint your experience would suggest—for strength to stand the extreme stress ; for combination of metals that expand and contract just right ; for a mechanism that harmoniously adapts itself to any condition, extreme or otherwise ; for ease and comfort of operation; for convenience of packing; and for the record they have made in actual service under as hard conditions as they would ever experience in your service.

We would have you do this piece of inspection so critically that you would *be sure*—remembering, too, that our guarantee accompanies every valve we sell.

Come see the valves under construction in our plant, built as carefully as a Corliss Valve gear is built, built for endurance, built not cheaply, but built *right—for Economy's Sake.*

Made as carefully as the finest piece of Machinery in your plant. Time-tested Nelson discs are the simple—and effective—mechanism that keeps valve tight, adjusting themselves to contraction by cold, to expansion by heat, or any other distorting influence. Best of cast irons or ordinary steels are too weak—therefore we use the strongest—*Acid Open Hearth Steel.* Bronze valve fittings disintegrate—therefore in all working parts we use Monel, the strong metal that cannot weaken or corrode. Thus you have a valve more than 65000 lbs.-per-sq.-in.-strong at every point, *reliable, safe,* for temperatures up to 800° F. *Absolute, thorough* inspection of every detail, *most rigid testing of every part from start to finish.* Test certificate plate fastened to each valve.

Make them strong ! Spare no care ! ! Must be right—and tight ! ! ! Test them hard ! ! ! ! These are the watchwords that govern their construction.

Nelson Valve Company
PHILADELPHIA

Montreal.
12-14 University St.

New York
30 Church St.

Chicago.
17 W. Kinzie St.

Pittsburgh,
517 Liberty Ave.

Minneapolis,
622 Andrus Building.

Butte, Mont.
56 E. Broadway

San Francisco,
22 Battery St.

Nelson Valves are made in the Gate, Globe, Angle and Check Types, in all sizes, of Iron, Bronze, or Steel, for all pressures, for any service.

If your dealer hasn't complete stock, write nearest Nelson office—WE WILL TAKE CARE OF YOU.

TRADE JENKINS MARK Jenkins Bros.

TRADE JENKINS MARK Jenkins Bros.

"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for ***genuine*** "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL

WHEN ONLY THE BEST WILL DO

Buy the "EVERLASTING" Blow-off Valve

HAVE YOU CONSIDERED THIS?

Every gallon of water leaking from your boiler costs you a pound of coal.

At least a pound.

"IT NEVER LEAKS"

ENGINEERING AND POWER HOUSE SPECIALTIES.

BRASS AND IRON VALVES.

PIPE AND FITTINGS,

FLANGED FITTINGS.

STEAM TRAPS.

PUMP VALVES, FEDRALITE.

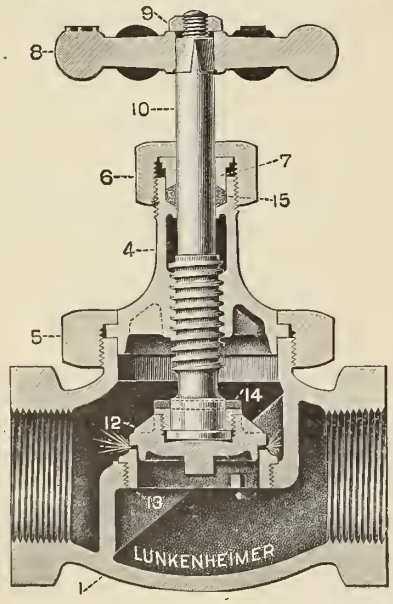
PACKINGS.

Engineering Specialties Company

1080 King Street West TORONTO, ONTARIO

Agents: H. L. PEILER & CO., 360 St. James Street, Montreal, Que.

LUNKENHEIMER "RENEWO" VALVES



ARE POSITIVELY THE MOST DURABLE AND PRACTICAL MADE.

THE SEATING SURFACES CAN BE RE-GROUND and ALL PARTS SUBJECTED TO WEAR CAN BE RENEWED, including the DISC and SEAT. The SEAT is SELF-CLEANSING and is made of a hard, close-grained nickel.

The bronze used contains a high percentage of copper and tin. The improved construction of the disc PRESERVES THE SEATING FACES and PREVENTS WATER HAMMER.

LUNKENHEIMER "RENEWO" GLOBE, ANGLE and CROSS VALVES are made in two patterns—medium and extra heavy—and are guaranteed for working pressures up to 200 and 300 pounds per square inch, respectively. They are made in sizes ranging from ¼ to 3 inches inclusive.

"Most supply houses sell them—yours CAN—if they DONT or WONT—tell US."

THE LUNKENHEIMER COMPANY

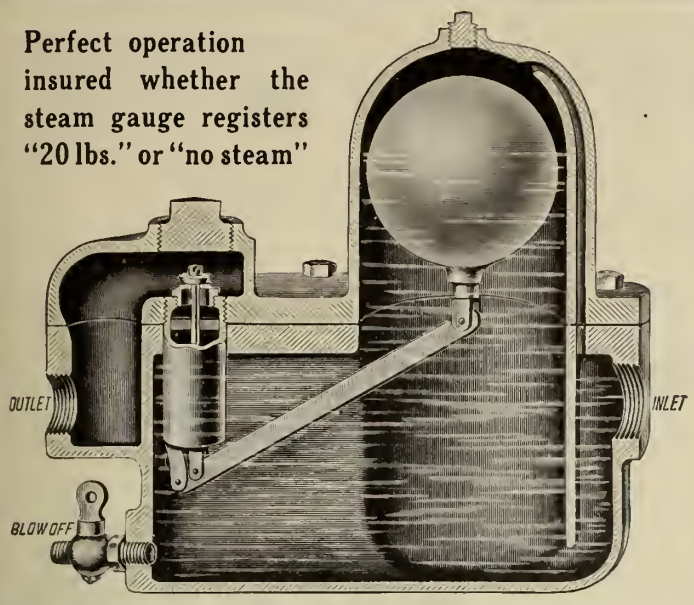
Largest Manufacturers of high-grade Engineering Specialties in the World.

General Offices and Works: - - - - - CINCINNATI, OHIO, U.S.A.

CHICAGO	NEW YORK	BOSTON	LONDON, S.E.
186 North Dearborn Street	64-68 Fulton Street	138 High Street	35 Great Dover Street

The advertiser would like to know where you saw his advertisement—tell him.

Perfect operation insured whether the steam gauge registers "20 lbs." or "no steam"



Wright "Victor" Low Pressure Continual Flow Steam Trap

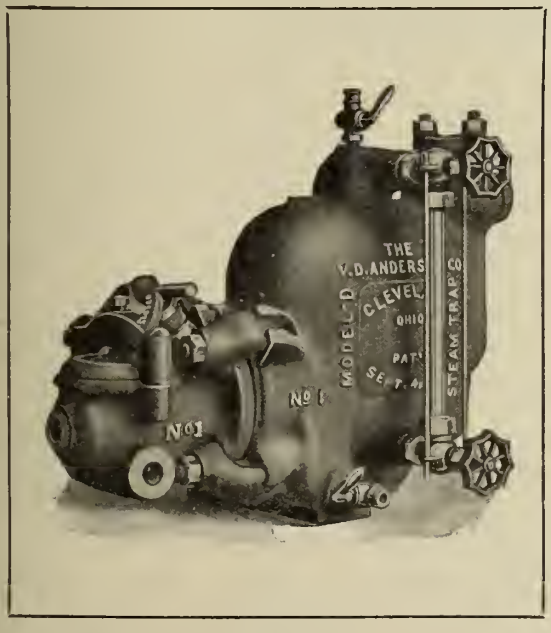
SEND FOR CATALOG

Keeps the water out of the Steam Line

Operating a steam system with Dry Steam insures the highest efficiency, with a minimum of expense. The Victor Trap is in universal use in low pressure systems. We ship on trial.

DARLING BROTHERS, LIMITED
15 Ottawa Street, MONTREAL
TORONTO ST. JOHN, N.B. WINNIPEG

The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

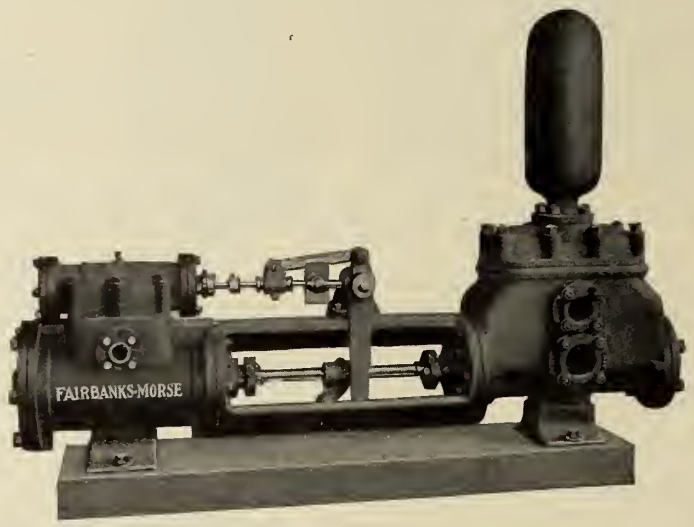
THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

FAIRBANKS-MORSE

DUPLEX PUMPS FOR BOILER FEED

AND

GENERAL USE



The Superior Excellence and Splendid Results shown by

FAIRBANKS-MORSE

Pumping Machinery are largely due to the fact that for many years we have manufactured Hydraulic Machinery of all descriptions. We are therefore able to build pumps of all capacities which are properly designed and adapted to every day use. You will get all that is essential and important in pumps when you purchase a "FAIRBANKS-MORSE" Pump.

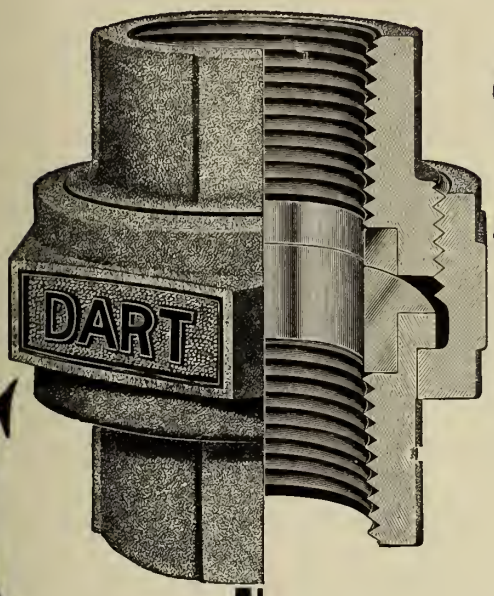
LET US SOLVE YOUR PUMP PROBLEMS.

The CANADIAN FAIRBANKS-MORSE CO., Limited

Fairbanks Standard Scales—Fairbanks-Morse Gas Engines—
Safes and Vaults.

MONTREAL	TORONTO	WINNIPEG
ST. JOHN	CALGARY	VANCOUVER
OTTAWA	SASKATOON	VICTORIA

That Joint



ALWAYS LOOK FOR THIS MARK

BRONZE TO BRONZE

Cannot Rust or Corrode

DID you ever consider why both faces of the joint on a Dart union are bronze? Pretty evident, isn't it, when one realizes why it is that the Dart union is always easily connected, and why it stays tight indefinitely when once joined.

By making your pipe connections with Dart unions you can be as sure that the joint will not leak as you can be of to-morrow's coming. They are always readily disconnected as the joint is bronze to bronze and not corroded or rusted. Then, owing to the bronze to bronze faces, the union can be repeatedly connected, in that permanent, unleakable joint, without the least expense or bother.

Look at a Dart union and note its shape and weight of iron parts. There is rigidity and wear there. This, combined with the joint, makes for the Dart union its enviable reputation.

What we say of Dart unions does not help you.

What you need to do is to get Dart unions, put them into use and watch results. You will have less pipe joint troubles than you ever dreamed possible.

Dealers throughout Canada sell Dart unions; and mind, every Dart union is guaranteed to give satisfaction.

DART UNION CO., LIMITED

93-97 Niagara Street - TORONTO, ONT.

The advertiser would like to know where you saw his advertisement—tell him.

WE ARE SPECIALISTS IN RELIABLE ENGINEERING GOODS

ASHTON VALVES; MASON REGULATING DEVICES; BUNDY TRAPS, Etc.

H. L. PEILER & COMPANY, 380 St. James Street, MONTREAL

69 Adelaide St. E., Toronto. | Western Agents: W. E. SKINNER, Limited, 618 Somerset Bldg., Winnipeg. | McLeod Bldg., Moncton, N.B.

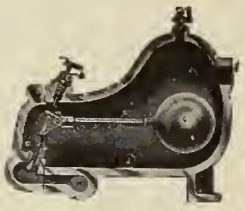
McDANIEL IMPROVED STEEL TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St. MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.
820 Euclid Ave., TORONTO, ONT.

Mueller Pressure Reducing and Regulating Valves

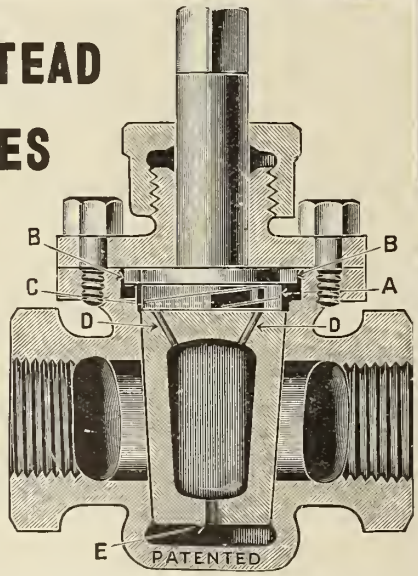
Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

DOHERTY MFG. CO., Limited
Sarnia - Ontario

Manufacturer for The H. MUELLER MFG. CO., Decatur, Ill., and New York City.

HOMESTEAD VALVES

Have no Equal for Simplicity and Durability



They are unexcelled for any service involving the handling of high pressures in steam, gas, water or hydraulic work. The seats are absolutely protected against wear. The plug is balanced and held in place by pressure when open, and when closed it is locked in the seat by our patent wedging cam. That's what makes Homestead Valves outwear all others.

A quarter turn opens or closes the valve—no waste of time or energy.

A catalogue describing Homestead Valves is yours if you tell us where to send it.

Homestead Valve Mfg. Co.
Works: HOMESTEAD, PA.
P.O. Box 1754, Pittsburg

QUALITY

Counts in

Gauge Glasses

Bishops ADAMANT

will withstand the highest Steam Pressures and all variations of temperature.

ADAMANT GLASSES

have been tested under all conditions and have proved their superiority over all others.

Write us for Further Particulars

J. R. Baxter & Co.
Mill Supplies MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.

THE "ECONOMIC" VACUUM VALVE

Will Keep YOUR RADIATORS Always Hot With A Minimum Fuel Consumption

This Vacuum Valve has been produced after careful study with an aim to produce better results from steam used in heating dry kilns, factories, etc. It can be easily and quickly attached to the old gravity type of heating apparatus as well as the new system, and will enable the radiators to give the maximum heat from a minimum fuel consumption.

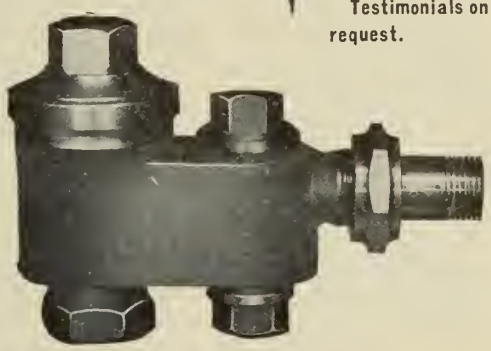
It has two chambers, the first being a dirt catcher, in which the condensation is screened before the steam enters the second chamber. The second chamber is a perfect valve which positively retains all steam and eliminates the air and water of condensation automatically by means of a float.

The condensation chamber is very simple and can be cleaned by simply removing the cap at the bottom, then the screenings fall out.

Back pressure on engines supplying the exhaust is impossible.

Better investigate this valve at once. A post card will bring particulars by return mail.

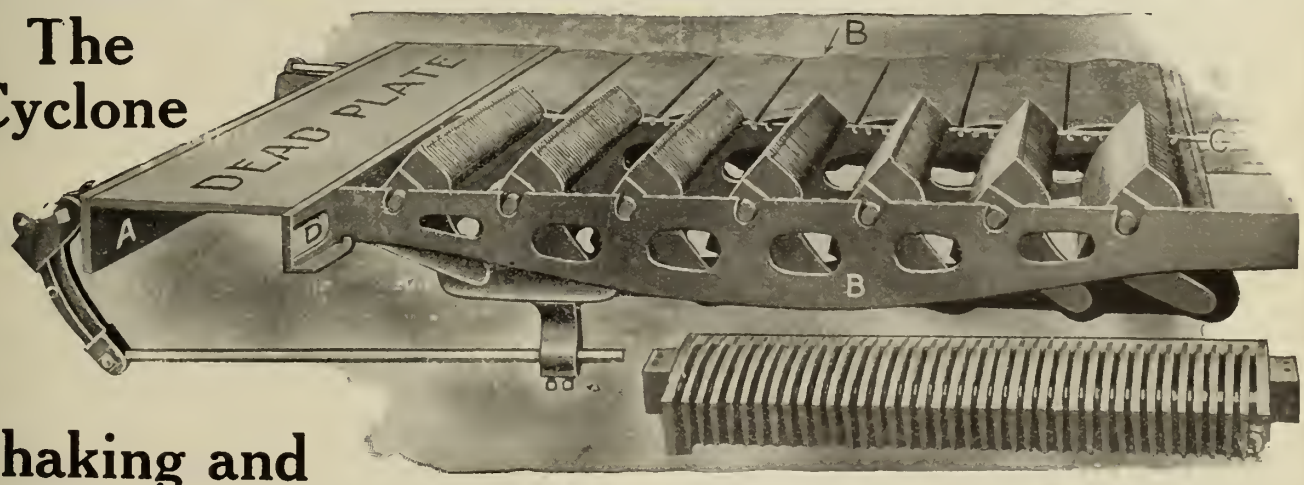
Testimonials on request.



Canadian Steam Boiler Equipment Co. *Limited*

186 Queen Street East, Toronto.

The Cyclone Shaking and Dumping GRATE BAR



has an improved shaking mechanism, in which the shaking is rendered much more vigorous. No ashes can remain upon the centre of the grate, the place where, in other makes, they usually are found to cling. This grate bar cannot get out of plumb. With it you can get perfect results from burning the cheapest grades of fuel. This ensures fuel economy.

WRITE US FOR FULL PARTICULARS AND PRICES TO-DAY.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

186 QUEEN STREET EAST - - - - TORONTO, CANADA

AGENTS:—ST. JOHN, N. B., F. W. Blizzard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 38 St. James Street. HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited. BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, The Vulcan Iron Works.

The advertiser would like to know where you saw his advertisement—tell him.

The Murphy Automatic Smokeless Furnace

Commercially on the market 30 years. It is not an experiment.

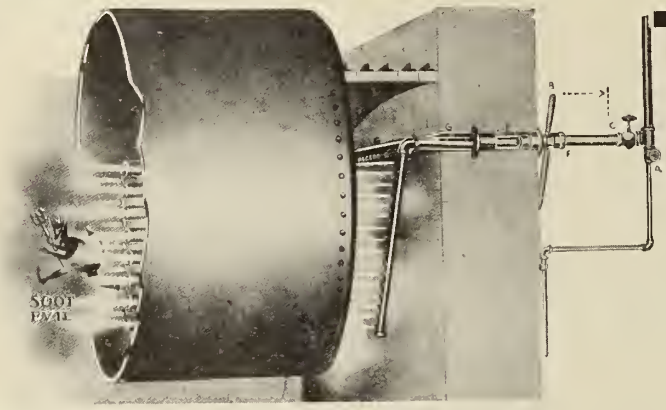
THE FIRST INSTALLATION IN CANADA, 1894.

To March 1912: 50 contracts, 11 repeat orders, 131 furnaces—25,133 h.p., and NO KICKERS.

If you want to increase capacity from boilers about 25 per cent., decrease cost for power about 25 per cent., and eliminate the smoke nuisance, write to-day for a catalogue and we will send you a complete list of installations.

SMOKE IS EVIDENCE OF WASTE OF HEAT—MONEY—VALUE OF FUEL.

MURPHY IRON WORKS, DETROIT, MICH. BUFFALO, N. Y.



The Vulcan Cleaning a Return Tubular Boiler.

CLEANING WATER TUBE BOILERS IS ALSO OUR SPECIALTY

OUR FREE BOOKLET.

"Economical Steam Production" fully describes the Vulcan Soot Cleaner and is a complete and pointed discussion on soot and how to get rid of it.

Write for a copy now.

Sign, tear out and mail

Power House 3-12.

Date.....

Vulcan Tube Cleaning Systems, Limited, Montreal,—

Please send us, without charge, your hook—ECONOMICAL STEAM PRODUCTION, and your proposition.

(It is important that the following information be given in full.)

Water Tube Boilers.

No. of Boilers..... Type..... Pressure.....

Horsepower ..... No. Tubes High (except on Stirling boiler).....

Any Superheaters ..... Width of alley space at side .....

Name .....

Tubular Boilers

No. of Boilers ..... Horizontal or Vertical .....

Address .....

2 MINUTES

To Clean Your Return Tubular Boiler If You Use the

Vulcan Soot Cleaner

The Vulcan Soot Cleaner is a Fifty-five Dollar Boomerang. It hits the coal man pretty hard, but it is good to you.

Your Fifty-five Dollars come back two or three times a year **in coal saved**—pretty good returns on a small investment. It costs money fighting soot in the **Old Way**. It saves money removing soot in the **New Way**.

The Eddy Paper Co., Three Rivers, Mich., has been saving $450.00 to $750.00 per year on an investment of $165.00 in Soot Blowers. See what they write:—

"The three soot cleaners you sold us a few years ago are away ahead of the old style system of cleaning flues. We save 3 to 5% in fuel, and as our fuel bill is about $15,000 per year. the cleaners not only paid for themselves in 6 months, but saved us considerable besides. Unfortunately very few engineers realize the loss from sooty flues."

Why not act now? Put a Vulcan to the test. To remove all chance of risk for you, every Vulcan for Return Tubular Boilers is

SOLD ON 30 DAYS' TRIAL

Vulcan Tube Cleaning Systems
Limited
4-11 Bonsecours Street, Montreal

"Typhoon" Turbine Blower

System of Mechanical Draft

Increases Boiler Efficiency. ***Ensures Fuel Economy.***

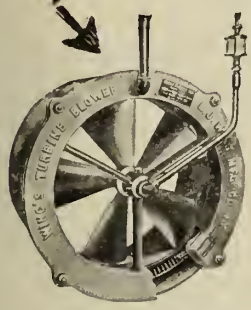
This simple, practical and very effective machine has become indispensable in many boiler-rooms.

It produces a powerful forced draft, which not only increases the boiler's efficiency but also permits the use of the cheapest grades of fuel, and keeps the grate free from clinkers.

The blower can be automatically controlled so that it will stop and start with the rise and fall of steam pressure.

If you want better results, and a saving of 25% in fuel costs, you had better write at once.

A card will bring circulars by return mail.



Exterior View
Blower Complete

The Hare Engineering Co., Limited

14-16 King Street East, TORONTO

Interior View
Casing Removed

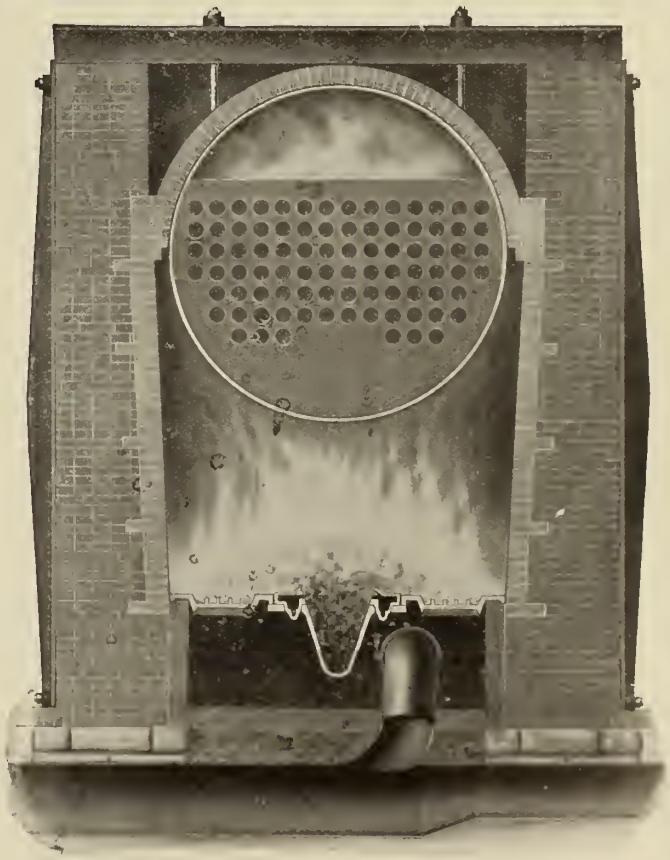
NO LOSSES

THERE are no grate bars in a Jones stoker, consequently NO LOSS of fuel through the bars.

The gases are driven off the coals and mixed with air ***beneath*** the fuel bed, pass through the fire, are brought up to the ignition temperature and consumed, consequently NO LOSS in unburned gases! NO SMOKE!

Utilizing the fuel with a minimum of loss, and with the automatic regulation of the steam pressure by the steam pressure itself, make a Jones Underfeed Stoker installation an ideal system of firing a steam boiler plant.

Let us tell you more about it.



Jones Underfeed Stoker Co., Limited

National Trust Building
TORONTO

Coristine Building
MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.

Every Up-to-Date Plant Should Investigate

The "Stanlock" System

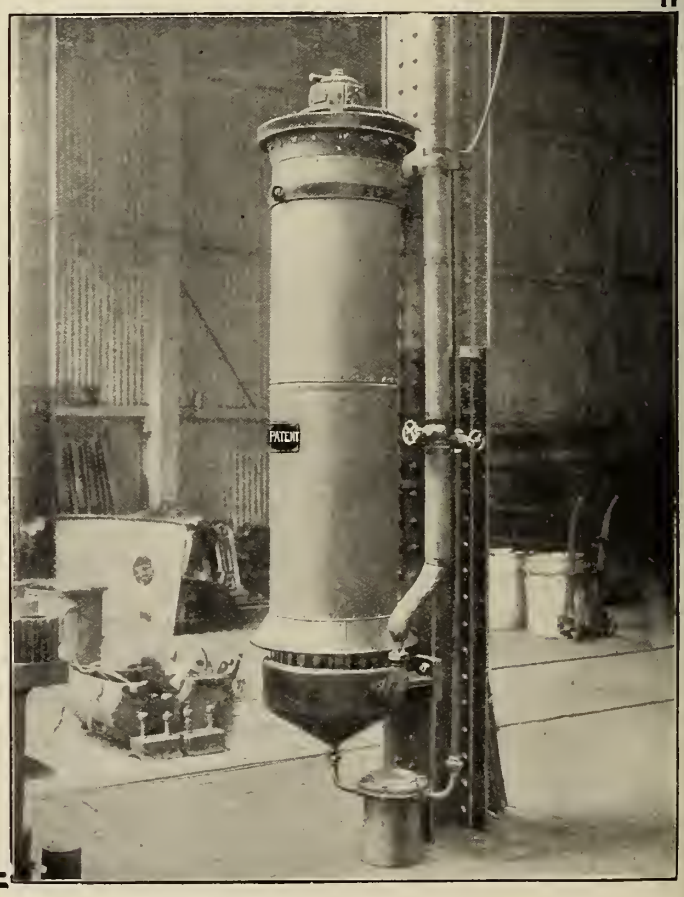
of

Heating and Ventilating

This system consists of units as shown below. They are made of steel tubes screwed into circular cast iron bases and through these tubes steam passes. Enclosing these tubes is a sheet metal cylindrical casting with a motor at the top. The air is forced downwards, thus keeping the floor warm. A special pipe can be fitted, passing through the roof or through the side wall, thus giving a supply of fresh air. Dampers are provided so that the inside air can be circulated or outside air can be taken in and heated.

Advantages of the "Stanlock" Multiple Unit System

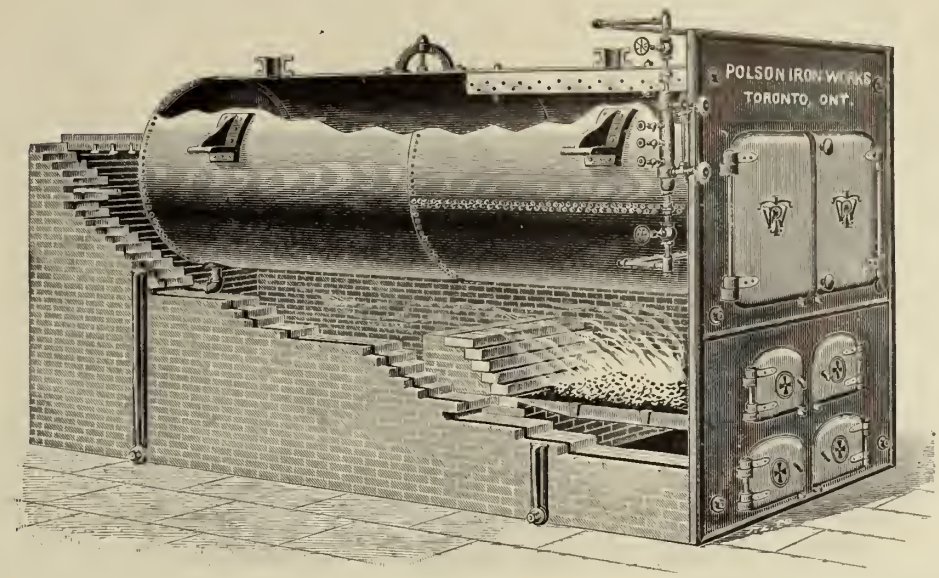
1. No overhead air ducts are required.
2. No underground masonry ducts are required.
3. No obstruction to light due to overhead air ducts.
4. No heat losses due to radiation from air ducts.
5. Minimum of power absorbed.
6. Units hung on walls. No floor space needed.
7. Various units operated independently and can be turned on or off like radiators. Some supply fresh heated air and others merely circulate and heat.
8. A unit using 60 lb. steam pressure heats 3,600 sq ft. of floor space.
9. The first cost of apparatus is very low.
10. Units may be added at any time in case of extensions, and in case of boiler shops, units may be removed entirely during the summer months, if desirable.



The Garth Company

Selling Agents for the Dominion of Canada

26-32 Craig Street West - MONTREAL



HORIZONTAL
RETURN TUBULAR BOILERS

BUILT FOR ANY PRESSURE DESIRED. BUILT TO PASS INSPECTION IN ANY PROVINCE. ARRANGED FOR ANY SETTING REQUIRED, WHETHER IT BE STANDARD, DUTCH OVEN, OR SPECIAL. BOILERS WILL BE BUILT TO REST ON BRICKWORK, OR FOR SUSPENSION FROM GIRDERS AND BEAMS.

THE BEST MATERIAL, MANIPULATED BY EXPERIENCED WORKMEN, ENSURE A FIRST CLASS BOILER.

We Employ Both. ***Consult Us.***

POLSON IRON WORKS, LIMITED

STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

TORONTO **CANADA**

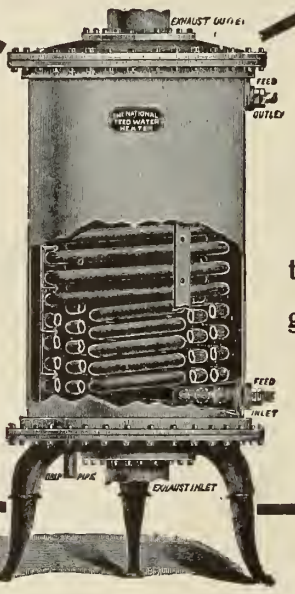
REPRESENTATIVES IN CANADA FOR

The B. F. Sturtevant Co., Hyde Park, Mass., U S.A., Fans, Blowers, Heating and Ventilating
The John I. Thornycroft Co., London, England, Marine Motors

FUEL ECONOMY

prevails in every boiler room if the feed water is heated to boiling point with the

NATIONAL Feed Water Heater



The Heater that cannot get out of order.

The Heater that most engineers choose.

The National is so constructed that the feed-water never comes in contact with the shell and at no time is the shell subject to boiler pressure, consequently corrosion or leakages are impossible.

Coils of seamless drawn brass or copper tubing, in a shell of cast iron or steel, carry the feed-water; exhaust steam admitted to the shell, heats the water in the tubes.

Our catalog gives full description—write for it to-day.

The National Pipe Bending Co.

91 Lloyd Street

NEW HAVEN, CONN, U.S.A.

One Unnecessary Expense

can be easily and quickly removed by installing

The "OTIS"

TUBULAR FEED WATER HEATER AND OIL SEPARATOR.

The exhaust steam, passing through this apparatus, heats the water to a boiling point before it enters the boiler and thereby saves a large amount of fuel that would otherwise be required, also saves your boilers.

It has an oil separator which extracts all oil from the exhaust, thereby eliminating the necessity of an extra oil separator.

It is simple, durable and absolutely reliable.

If you want to economize, the "Otis" will help you.

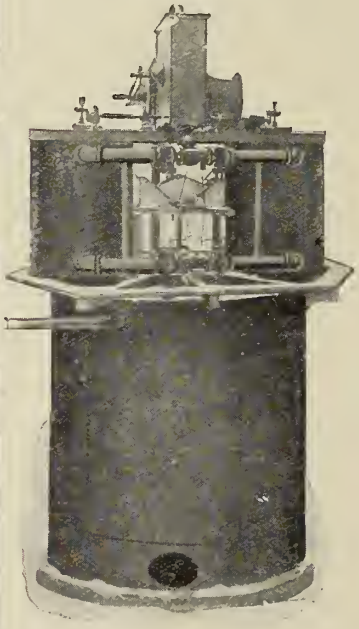
The STEWART HEATER CO.

189 Norfork Ave., Buffalo, N.Y., U.S.A.

LORD'S

Water Purifying Chemicals

Water Softening Systems



For the Treatment of all Waters, Hot or Cold

We have no one method. We recommend and furnish the system best adapted to the individual need, whether it be water softeners or direct chemical application.

We offer you the benefit of our 50 years of accumulated information in this line.

Glad to answer questions or make suggestions, without putting you under any obligation to accept our recommendations.

Geo. W. Lord Company

PHILADELPHIA - SAN FRANCISCO

Agencies in all principal cities.

BENNIS CHAIN GRATE STOKER

More air space is provided in each square foot of grate area without additional widening of the **actual** air spaces.

The continuous surface of the grate ensures economy in the length of the grate.

By means of the continuous drive, smoothness of running is assured.

The speed of the stoker can be adjusted to a nicety, as there are six variations.

The stoker can be easily hand-fired in case of emergency.

Fine slack fuels can be satisfactorily burnt.

For Full Particulars Apply to

GEO. H. TOD 213 Manning Chambers Queen Street West **TORONTO**

Water Softening, Filtration and Purification

For Boiler Feed and Manufacturing Purposes

The sources of financial loss from the use of impure water for Boiler Feed purposes are: *Incrustation, Corrosion and Foaming,* all of which mean:

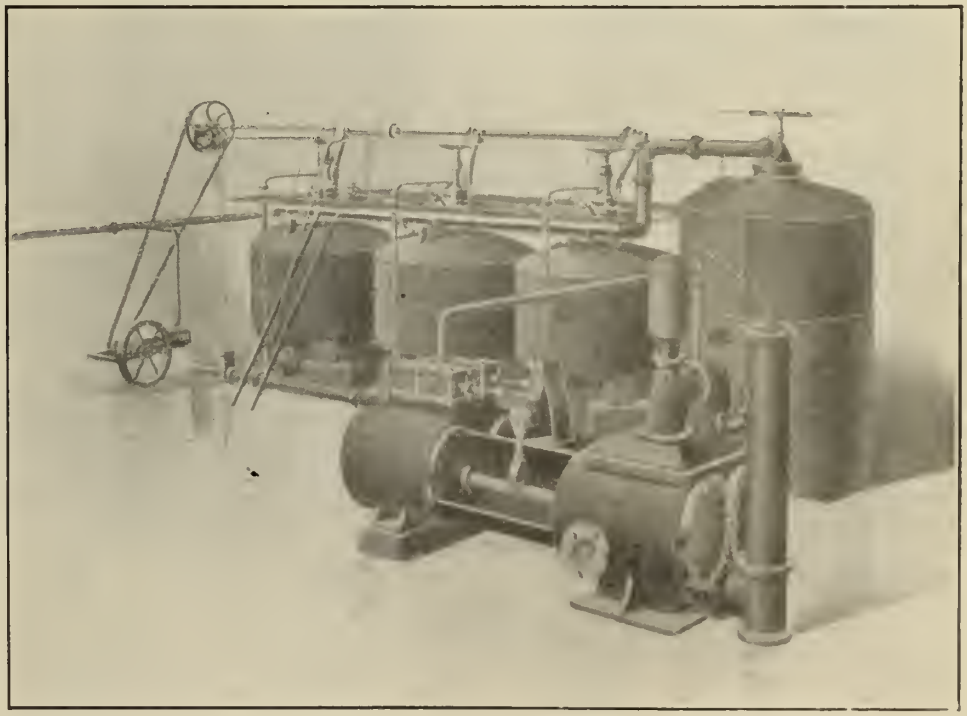
Increased Cost of Fuel
Increased Boiler Repairs
Increased Time for Boiler Cleaning
And Shorter Life of Boiler

Prominent features of the BELL FILTRATION PLANT are its reliability of purpose and operation; its requirements of the minimum attention, its ability and capacity to obtain softness and purity of the hardest and most highly contaminated water, so that steam and other boilers may be kept entirely free from deposit and scale.

A conservative estimate places the average loss of fuel efficiency at 13% for every 1-16 inch of scale on heating surface. This applies equally to locomotive, stationary and heating boilers, whether soft or hard coal is used for the generation of steam.

Manufactures, such as Bleaching, Dyeing, Brewing, Distilling, Sugar Refining, etc., are assured of the highest degree of purity of their various products.

The Filters are equipped so that they may be washed out each day or oftener, the operation involving only from 3 to 5 minutes. This ensures the filter sand being kept sharp, clean and effective, without which it is otherwise useless.



Water Softening and Filtration Plant erected for a firm of Dyers and Bleachers. Capacity 600,000 gallons per 24 hours.

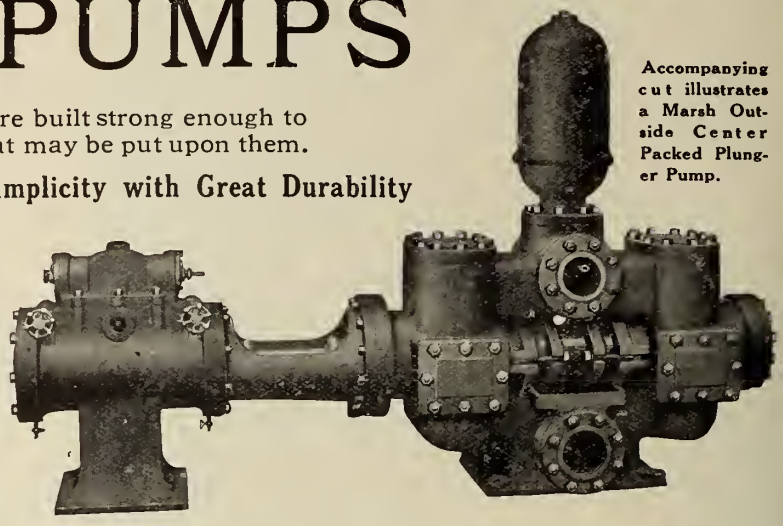
Bell Filtration Co. of Canada, Limited, Head Office, 305 Kent Building Toronto - - Canada

The advertiser would like to know where you saw his advertisement—tell him.

MARSH PUMPS

Are the heavy, massive kind, that are built strong enough to withstand any unforeseen strain that may be put upon them.

They Combine Efficiency and Extreme Simplicity with Great Durability



Accompanying cut illustrates a Marsh Outside Center Packed Plunger Pump.

TAKE the pump shown here, for instance, note the massive construction, note the absence of outside moving parts on the steam end and the general simplicity in construction throughout. The Marsh Pumps are not cheap in any sense of the word. They are built for long, continuous service and every pump is absolutely guaranteed for the service on which it is recommended. We stand back of all our material and workmanship for one year.

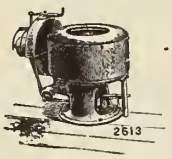
Our new No. 18 general catalog illustrates and describes the different types of Marsh and American Pumps. Write to-day for your copy. It is a treatise and reference book every engineer and power plant superintendent should possess. It is free on request.

CANADIAN AGENTS

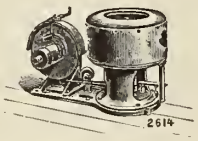
A R. Williams Machinery Co., Toronto
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Hallman & Peniston Machinery Co., Vancouver, B.C
Mechanics' Supply Co , Quebec, Que.
Gorman, Clancey & Grindley, Limited,
Edmonton and Calgary.

AMERICAN STEAM PUMP COMPANY

Battle Creek, Mich.



BELT DRIVE



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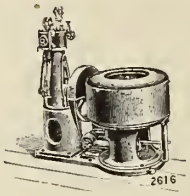
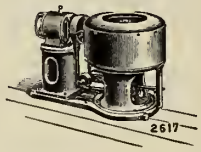
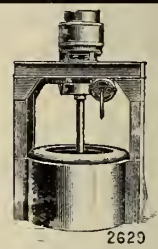


ENGINE DRIVE

WATER DRIVE



ELECTRIC DRIVE

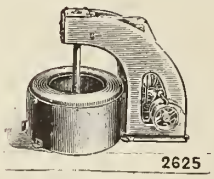


ELECTRIC DRIVE

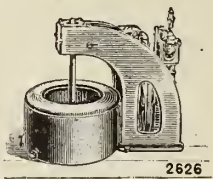
BELT DRIVE

HYDRO-EXTRACTORS

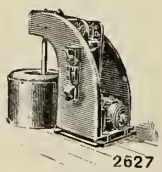
To Meet All Requirements



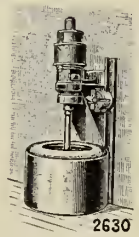
BELT DRIVE



ENGINE DRIVE



ELECTRIC DRIVE



ELECTRIC DRIVE

WATER DRIVE

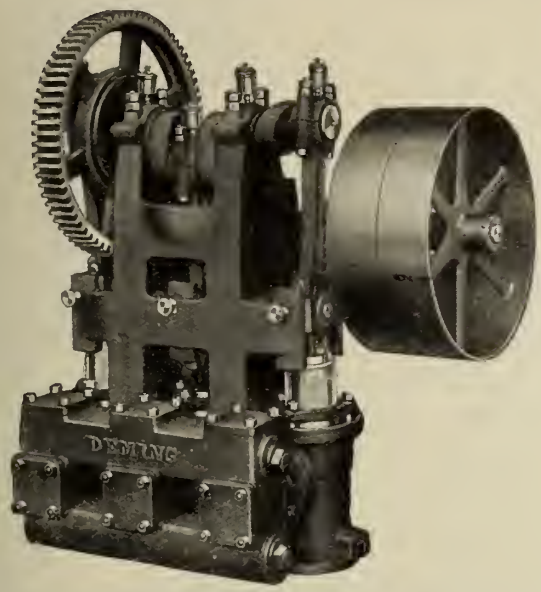
WATSON, LAIDLAW & CO., LTD.

98 DUNDAS STREET (South), GLASGOW

For further particulars, apply to:---

JONES and GLASSCO, St. Nicholas Building, Montreal.

DEMING POWER PUMPS
NECESSARY IN POWER PLANTS



Belt Driven Deming Triplex Power Pump. For boiler feeding, tank service, general water supply, etc. Can be direct-connected to motor.

Not only in the "long run" have Deming Pumps demonstrated their money-saving qualities—but right from the start they have "delivered the goods," and in factories where "Scientific Management" is practiced, there you will find Deming Power Pumps

If you need a pump in your factory, you need our Catalogue. Tell us what you want the pump to do.

The Deming Company
Salem, Ohio :: U.S.A.

Hand and Power Pumps for all Uses.

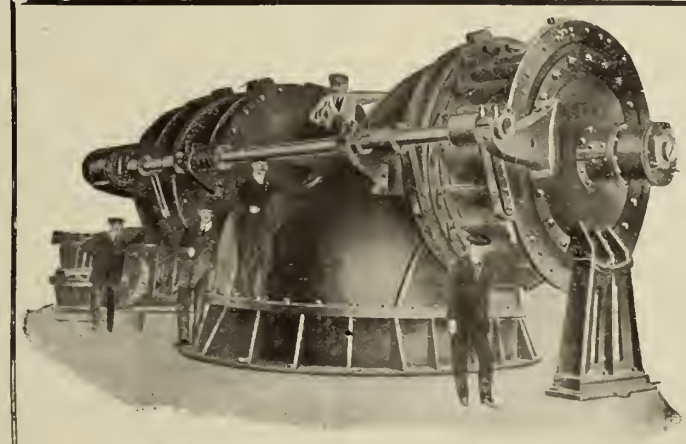
GENERAL AGENCIES

HENION & HUBBELL, Chicago, Ill.; MORAN ENGINEERING CO., Seattle, Wash.; DARLING BROS., Montreal, Can.; HENDRIE & BOLTHOFF MFG. & SUPPLY CO., Denver, Colo.

WATER TURBINES
—AND—
GOVERNORS

All Sizes

Maximum Efficiency



All Heads

Ideal Control

ASK FOR PARTICULARS FROM

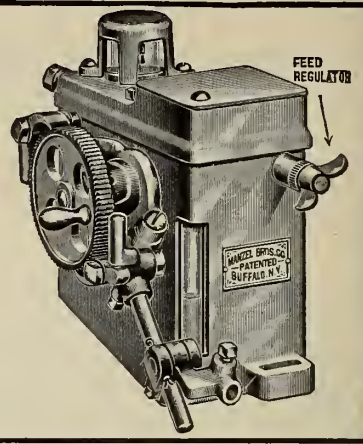
THE CANADIAN BOVING CO., LTD.

164 BAY STREET, TORONTO.

Branch Office for British Columbia, 427 Seymour St., Vancouver

The advertiser would like to know where you saw his advertisement—tell him.

Let Us Send You a Manzel Oil Saving Oil Pump on Thirty Days' Trial



30% OIL SAVING GUARANTEED

You may be able to save as high as 60%. Many others have done so. The "Manzel" New Model Oil Saving Oil Pump is a positive lubricator. It oils the cylinders right all the time, and makes a big reduction in oil bills, besides saving labor and wear and tear on the engine.

You can try a "Manzel" Pump with the distinct understanding that it may be returned at our expense if it doesn't reduce your oil bills at least 30%.

Send for one on these conditions. Catalogue on request.

MANZEL PUMPS are carried in stock by

THE TWIN CITY OIL CO.
General Agents Ontario and Quebec
Berlin, Ontario.

BAYFIELD & ARCHIBALD
General Agents for the Northwest.
Molsons Bank Bldg., Vancouver, B.C.

Write to either of the above firms for catalog and full information. MANZEL BROTHERS CO., Buffalo, N.Y.

When All Others Fail

GERMAN VALVE CYLINDER OIL,
GERMAN ENGINE OIL.
STERLING FAST ENGINE AND DYNAMO OIL,
STERLING FRICTIONLESS COMPOUND

will cure your troubles.

Canadian Oil Companies Limited,
Toronto, Winnipeg, Montreal, St. John, Halifax, Calgary.

The Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars

Morehead Mfg. Co.
DEPT. "J." DETROIT, Mich.

Canadian Representatives—Geo. W. Cole, c/o A. R. Williams Machinery Co., Toronto, Ont.; H. E. Kirkham, Montreal; Park Bros., Chatham, Ont.; W. H. Rosevear & Son, Winnipeg, Man.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

W. A. CROCKETT
Executive Secretary
MT. HAMILTON, - - ONTARIO

Detroit Lubricators for every purpose

Detroit Lubricators are made in styles and sizes for every kind of service.

Regardless of the conditions under which it must operate, there is a Detroit Lubricator that will eliminate every element of chance of uncertainty from the lubrication of the machine with which it is installed.

Every lubricator is carefully designed for the work it is to do and embodies in a compact and well balanced design all of the esentials of a perfect lubricating device.

Detroit Lubricators are characterized by all of the refinements and improvements made possible by long experience in the sale and manufacture of lubricating devices of every kind and by careful study of the varied conditions under which they are used on all kinds of engines, all over the world.

Engineering Service Department

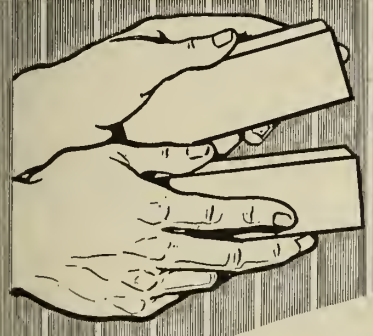
The Detroit Lubricator Company maintains an engineering department that is at the service of users of lubricating devices. It is our aim to assist every owner of a Detroit Lubricator to get the greatest efficiency from it.

If he is not sure as to the exact style and size of lubricator his machine needs, if he is in doubt about the proper method of installation and operation—if he needs help of any kind, he can write us and our service department will be glad to to help him.

DETROIT LUBRICATOR COMPANY.

DETROIT, U.S.A.

Largest manufacturers of lubricating devices in the world.



ALBANY GREASE

Take Two Flat Pieces of Steel

Rub them rapidly together under pressure. Note the friction and heat.

Next put a few drops of oil between them and note that most of the oil drops to the floor, while the little that remains is soon used up.

Now put a little

ALBANY GREASE (All Lubricant—No Waste)

between the pieces of steel and note the difference—the ease with which they move, and how Albany Grease *remains where needed.* Note how long it lasts.

Then ask yourself which is the best for the bearings of *your* machinery, that rub and move, just as did the two pieces of steel.

Consider which has reduced friction and which has proven itself to be **All Lubricant—No Waste.**

Let us send you a **Free** testing sample of **Albany Grease**, a Grease Cup and a copy of our new booklet "Death to Friction."

ALBANY LUBRICATING CO.

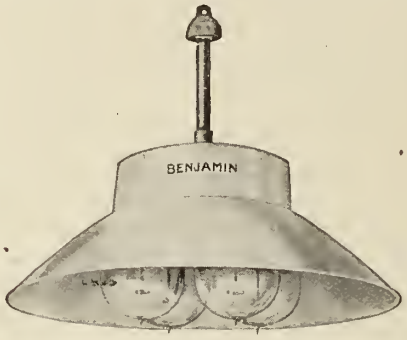
Adam Cook's Sons, Proprietors. **708-710 Washington St., New York**

The advertiser would like to know where you saw his advertisement—tell him.

ILLUMINATION

means increased quantity and quality of output—fewer faults in the finished product—more profit.

The reflectors here shown may help you to solve your lighting problems. If not, we have any quantity of other makes and styles that will just meet your requirements.

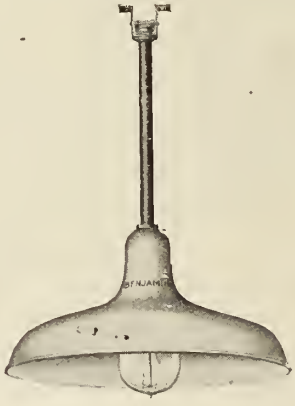


BENJAMIN REFLECTOR SOCKETS

will take lamps ranging from 40 to 500 watts. They are equipped with shock absorber—the Tungsten Life Preserver. Note the one piece feature of the reflector. There are no loose connections to allow the reflector to slide down and damage the socket. The former depends entirely on the stem for its support.

HOLOPHANE D'OLIER STEEL REFLECTORS

For factory lighting, where extreme concentration of light is desirable, and where the lighting units are attached directly to the machines and close to the work, these types will prove very satisfactory.



BENJAMIN MILL CLUSTERS

are furnished with large base (Edison No. 1) sockets and have either flat cone reflectors where fixture is suspended near the floor or concentrating dome reflector, where lights must be hung to clear traveling cranes.

Write to-day for our Bulletin No. 2070 and

REMEMBER—GOOD LIGHTING COSTS LESS THAN POOR LIGHTING.

THE Northern Electric AND MANUFACTURING CO. LIMITED

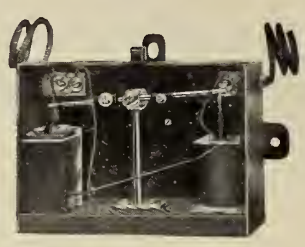
Manufacturer and Distributor of

Telephone Apparatus, Electrical Supplies, and Fire Alarm Apparatus for every possible need.

Address our nearest house.

Montreal, Toronto. Winnipeg, Regina, Calgary, Vancouver.

TEAR OUT



THIS AD.

Send it to us and we will mail you circular on Shedrick Controller.

This controller will prevent flat rate customers from using more sockets than they pay for.

ELECTRIC SPECIALTIES

Manufacturing Company

157 Craig Street W, : : Montreal

Mr. Manufacturer

Are You Satisfied With

YOUR LIGHTING

Good lighting means better work.

If interested, write us.

A. H. WINTER JOYNER, LTD.

76 Bay Street Toronto, Ont.

"Consult a Specialist"

YOU WANT TO IMPROVE YOUR POSITION

THEN READ THE

LIFE OF JAMES WATT

INVENTOR OF THE STEAM ENGINE

By ANDREW CARNEGIE

An entertaining book for those interested in mechanics and power, dealing with the scientific and mechanical inventions of Watt's life and times and his relations with other noted scientists and inventors.

The author, as a practical engineer, possesses all the technical knowledge necessary to give actuality to his writing, and his book is alive with enthusiasm and appreciation. He has missed no point in the romance of Watt's career, with its many thrilling episodes and its study of human nature revealed in a realistic manner. Mr. Carnegie may not point out how to become a millionaire, but he certainly sets forth considerations which may help to influence many a working man to improve his position.

Cloth Bound. 164 Pages. Postpaid, $1.00.

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SUPPORT HOME INDUSTRIES

CANADIAN TESTIMONIAL No. 2.

A CANADIAN BABBITT METAL Manufactured in Canada for Canadians

THE METAL

HARRIS HEAVY PRESSURE
The Babbitt Metal without a Fault

THE UNSOLICITED TESTIMONIAL

Hawkesbury, July 21, 1911

To Canada Metal Co.,
Toronto

We are very much pleased with your Heavy Pressure Babbitt. It has given us complete satisfaction and we consider it as good as we were paying another firm 60c. for.

Hawkesbury Lumber Co'y, Limited
per Wm. G. Hall

HARRIS HEAVY PRESSURE is acknowledged the best BABBITT METAL for General Machinery Bearings

MANUFACTURED AND GUARANTEED BY

THE CANADA METAL CO., LIMITED

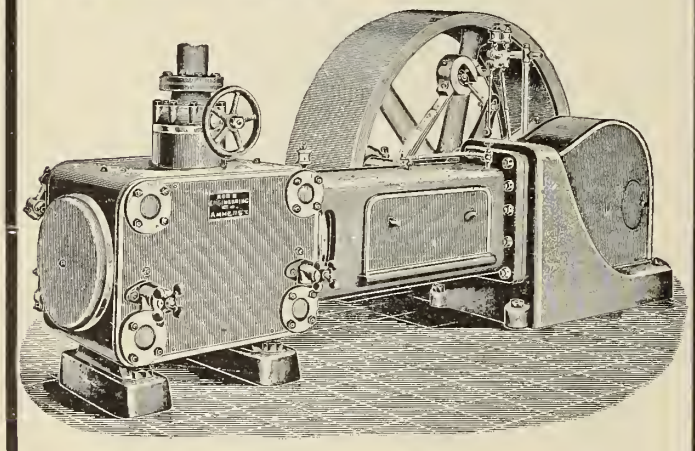
TORONTO AND WINNIPEG

The advertiser would like to know where you saw his advertisement—tell him.

Corliss Economy with a Positively Driven Valve Gear

By eliminating the springs, dashpots, latches and detachable parts of the usual forms of Corliss gear

ROBB CORLISS ENGINES



ARE SAFE because there's no governor belt to break, no releasing gear to fail to trip and allow the engine "to run away."

ARE SIMPLE because there is only about one-half as many parts and wearing surfaces in the valve gear.

ARE OF HIGH SPEED, the valves closing quickly and positively instead of depending upon the springs and dashpots of releasing gears. 200 revolutions per minute a safe speed.

Robb Engineering Co. Limited

WORKS:
AMHERST, N.S., CANADA
SOUTH FRAMINGHAM, MASS., U.S.A.

DISTRICT OFFICES:
Canadian Express Bldg., Montreal, R. W. Robb, Manager
Traders Bank Bldg., Toronto, - William McKay, "
Union Bank Bldg., Winnipeg, - W. F. Porter, "
Grain Exchange Bldg., Calgary, - J. F. Porter, "

39-10

These are the telling points about Bakelite

Valve Discs

THEY will not leak under high temperature, excessive pressure or when used in acids or other special liquids. Neither cold water, dry or superheated steam has the least effect upon them. BAKELITE Discs are a gas-tight fit.

BAKELITE is a successful substitute for expensive metal. Its structure is fibrous, giving strength and hardness. It can be reground and refaced, always retaining a uniform surface. It cannot be injured except by accident or friction.

Remember Bakelite PUMP VALVES do not warp with changes of temperature.

Order your valves fitted with Bakelite Valve Discs and stop that perpetual annoyance and expense caused by leaking valves. Depend upon it, Bakelite Valve Discs will not leak.

Write for prices or ask your dealer.

PLASTICS, Limited

Van Horne St., TORONTO

METALLIC PACKING

STEAM pressure, sliding friction, and moisture, make it difficult to properly lubricate piston and valve stem rods, hence a self-lubricating metal like Magnolia naturally proves superior to other metals for packing rings. We recently published some splendid letters from Engineers on that subject, and here is another fine letter:—

UNITED STATES ENGINEER DEPARTMENT.
U.S. DREDGE "WALLOWA"

Riparia, Wash., October 24, 1911.

GENTLEMEN—The Practical Engineer Pocket Book is just what the title implies: both practical and convenient for quick reference in and about the engine room.

I use Magnolia Metal for high-pressure steam packing on the main rods of the propelling engines. These engines have a piston speed of 150 feet per minute; diameter of rods, 3 inches; steam pressure, 225 lbs. per square inch. Four rings, or eight pieces, beveled Magnolia Metal rings, constitute the packing for each rod. I had a great deal of trouble with packing on the main rods before using Magnolia Metal, with different kinds of babbitt metals. The packing would melt or burn and crumble. I have at different times, when renewing packing, taken out from 30 to 48 pieces from each set, out of one stuffing box. Since using Magnolia for the rings, I have had no trouble whatever with the packing, and after the rings got conditioned to the rods no steam leaked by. To-day I examined the packing and rings and found them in as perfect condition as when I put them in four months ago, with hardly any sign of wear to them, and they look good for years of hard service. I cannot speak too highly of Magnolia Metal, and you may use this letter in any way you want.

Yours truly, JOHN OWRE,
Steam Engineer on U.S. Dredge "Wallowa."

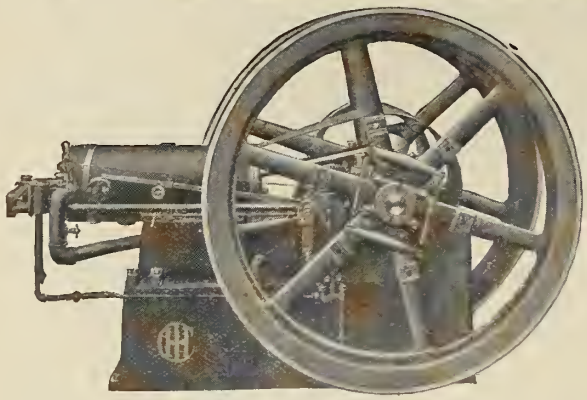
SPECIAL OFFER.

PRACTICAL ENGINEER POCKET BOOK: 680 pages, over 2000 subjects. Price 40c. postpaid. We do not aim to make a profit on these books. We buy them in large quantities as an advertising medium and give Engineers the benefit of low prices. They are highly spoken of by Engineers. **Address Montreal Office.**

Sold by leading dealers everywhere or by

Magnolia Metal Co.

225 St. Ambroise Street, Montreal
New York Chicago



1 to 50-H.P.—And Every One Reliable

Wherever you have occasion to use a compact, self-contained, economical prime mover, install an I H C Gasoline Engine.

There is an I H C Engine of a style and size to meet every power requirement. Each size in each style has stood the rigorous tests necessary to merit the I H C trade mark.

From 1 to 50-H.P.—water cooled or air cooled; horizontal or vertical; stationary or portable; and tractors from 12 to 45-H.P. —offers you a complete line of the world's best engines to select from—eliminating all risk. I H C Engines are built to operate on gas, gasoline, kerosene, distillate or alcohol.

For catalogue and complete information, address

International Harvester Company of America
(INCORPORATED)
50 HARVESTER BUILDING, CHICAGO U S A

THE
CANADIAN CASUALTY
AND
BOILER INSURANCE
COMPANY

SPECIALTY:

Boiler Inspecting, Reporting, Insurance, Evaporation Tests

CONTINENTAL LIFE BUILDING
TORONTO

J O. B. Latour
Chief Engineer

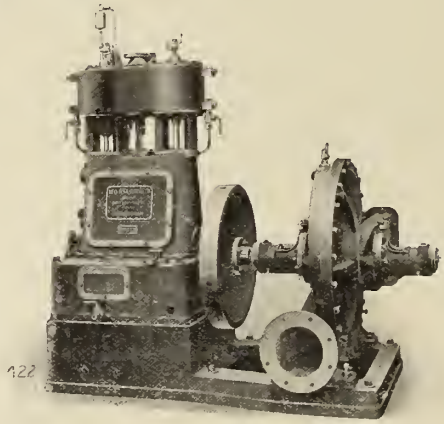
John J. Durance,
Manager.

Phone Main 6941.

A High Class Engine

Belliss Engines

are in use
as
Prime Movers
IN THE OPERATION
OF
EVERY DESCRIPTION
OF PLANT



Belliss Two-Crank Engine and High Efficiency Pump.

Belliss Engines

are well and favorably known from coast to coast in Canada.
THE ECONOMY
OF STEAM CONSUMPTION
being a factor in creating a demand for these Engines

Manufacturers:
BELLISS & MORCOM, Birmingham, England

Sole Canadian Representatives:

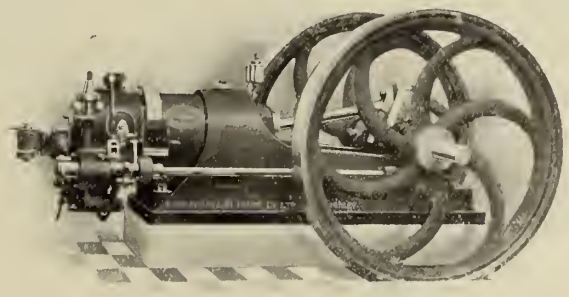
Laurie & Lamb

Board of Trade Building - - Montreal

If You Ever Buy Gas, Oil or Gasoline Engines,
It Will Pay You to Enquire About

IMPERIAL ENGINES

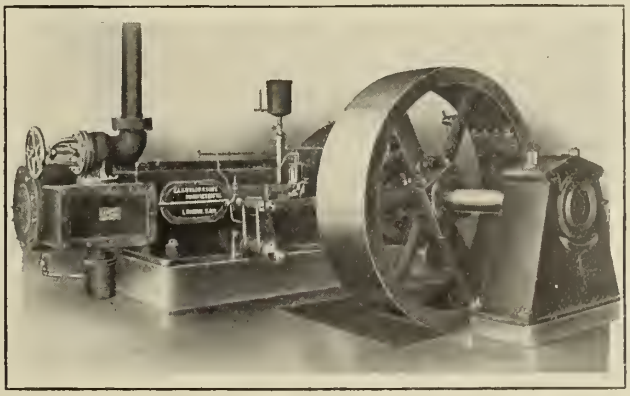
Quality Right



Price Right

Invented and Manufactured by the
KEIGHLEY GAS & OIL ENGINE CO.,
LIMITED
Imperial Works
KEIGHLEY, - - ENGLAND.

Sole Selling Agents in CANADA
H. W. PETRIE, Ltd.
Machinery Experts,
TORONTO, - - ONTARIO.
who will be pleased to give PRICES and SPECIFICATIONS.



Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY
E. LEONARD & SONS, LONDON, ONTARIO
MANUFACTURERS OF
High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants.
WAREHOUSES AND AGENCIES AT
MONTREAL, ST. JOHN, N. B., CALGARY, WINNIPEG, VANCOUVER

The advertiser would like to know where you saw his advertisement—tell him.

THE LINDE CANADIAN REFRIGERATION CO. LIMITED

C. W. Vollmann, President. 37 St. Peter St., Montreal

COMPLETE INSTALLATIONS OF MACHINERY AND INSULATION FOR

Cold Stores
Breweries
Abattoirs
Hotels
Dairies
Fur Stores
Candy Factories
Fish Freezing Plants
Chemical Works
Restaurants

and any other purposes for which artificial cold is required.

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

We are the Company which, under our old name of the Linde British Refrigeration Co., Limited, of Canada, has manufactured and installed all the "Linde" Refrigerating machines in Canada for the past sixteen years.

Ammonia Fittings and Corkboard carried in Stock. **WRITE FOR CATALOGUE.**

BRANCH OFFICES—Toronto, Imperial Building, Adelaide St.; Winnipeg, 110 James Street E.; Vancouver, Imperial Block, Seymour and Pender Streets; Edmonton, 562 Second Street.

The advertiser would like to know where you saw his advertisement—tell him.

THE LINDE BRITISH REFRIGERATION CO., LIMITED

ESTABLISHED 26 YEARS.

HEAD OFFICE, 35 Queen Victoria St., London, E.C.

DIRECTORS :

PROF. C. Von LINDE.
C. Von LANG PUCHOFF,
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R. C. GRANT,
G. H. LLOYD, Chairman,
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TRADE **LINDE** MARK

BRANCHES:

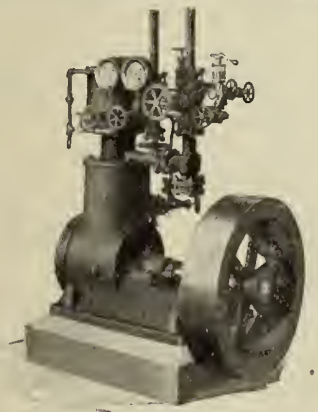
CALCUTTA
SYDNEY, N. S. W.
PORT NAPIER, N. Z.
JOHANNESBURG, S. A.
MONTREAL.

OVER **8000** MACHINES SOLD

for every purpose requiring

MECHANICAL REFRIGERATION

628-9 CORISTINE BUILDING, MONTREAL, P. Q.



Vertical Single-Acting Ammonia Compressor Enclosed Type for Belt-drive

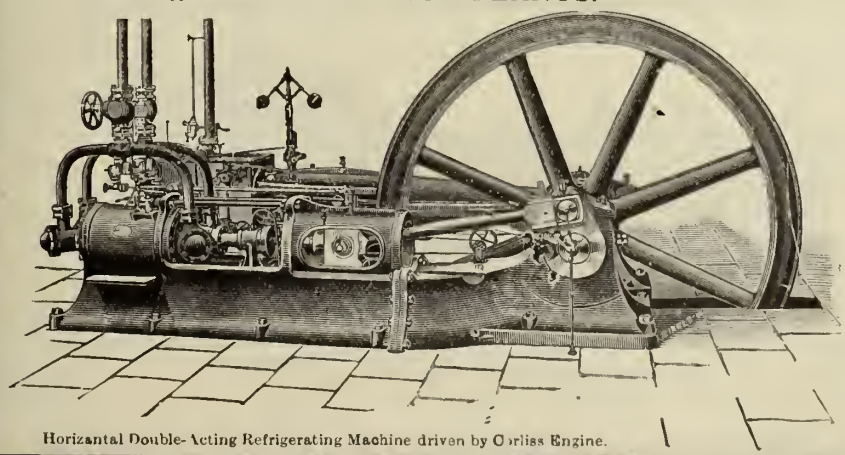
Our Plant covers more than 8 acres of ground. Established 1867.

THE VILTER MANUFACTURING CO.

242 Becher Street, Milwaukee, Wis., U.S.A.

Builders of High Grade CORLISS ENGINES

for Belted or Direct-Connected Service, Medium or High Speed (Girder or Heavy Duty Type Bed.) Perfect Regulation, Highest Efficiency. ***ICE*** and ***REFRIGERATING MACHINERY,*** Small Single-acting Vertical and Small and Large Double-acting Horizontal, any capacity. AMMONIA FITTINGS, AMMONIA PIPING, AMMONIA CONDENSERS, DOUBLE-PIPE BRINE COOLERS AND EQUIPMENTS FOR ICE PLANTS.



Horizontal Double-Acting Refrigerating Machine driven by Corliss Engine.

Some of Our Canadian Customers :

Windsor, Ont.—British-American Brewing Co.
Ingersoll, Ont.—Ingersoll Packing Co.
Hamilton, Ont.—F. W. Fearman Co., Ltd.
London, Ont.—Canadian Packing Co.
—London Machine Tool Co.
Rat Portage, Ont.—Rat Portage Lumber Co.
Winnipeg, Man.—Edelweiss Brewery.
—Winnipeg Fish Co.
Saskatoon, Sask.—Hoeschen-Wentzler Brewing Company.
Strathcona, Alta.—The Strathcona Brewing & Malting Co.
Rossland, B.C.—Lion Brewing Co.
Victoria, B.C.—Victoria Phoenix Brewing Co.
—Victoria Arena Co., Ltd.
Vancouver, B.C.—Vancouver Arena Co., Ltd.

The advertiser would like to know where you saw his advertisement—tell him.

Anhydrous Ammonia
Aqua Ammonia
Chloride of Calcium

Your orders placed with us will receive prompt attention. Established 1882.

INTERESTING! A new discovery for Refrigerating Plants.

"No-R-H-O." Paint (no-rust-hardening-odor.)

It keeps pipes **ABSOLUTELY** free from rust.

WILL NOT CHIP OFF (because it does not dry hard.)

HAS NO ODOR (therefore not injurious to foodstuffs.)

SAVES TIME AND LABOR
(when removing ice from pipes will cause the ice to break clean, overcoming "chipping."

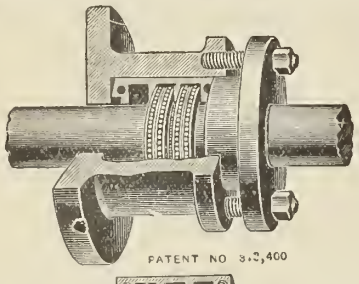
Some of our Customers

Wm. Davies Co., Limited.
Swift Canadian Co.
City Dairy Co., Limited.
T. Eaton Co., Limited.
Toronto Exhibition.
Matthews, Lang Co., Limited.
Cowan Chocolate Co., Limited.
British American Oil Co.
King Edward Hotel.
O'Keefe Brewing Co., Limited.
Christie, Brown Co., Limited.
Canadian Kodak, Limited.
Wm. Neilson Co., Limited.
Manning Cold Storage, etc., etc.

Agents for **STUART & FOSTER, Limited** Owning and Operating

The Canadian Ammonia Co. 474-476 Gerrard Street E. John G. Harvey, Limited

TORONTO, Phone N. 3760. CANADA.



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Why not Buy the Best, when in market for Packing?

HOLMES'

Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

WAINWRIGHT WATER HEATERS

A Unit saved from the exhaust is worth two in the coal pile.

WAINWRIGHT WATER HEATERS

are designed specially to fulfill the requirements of Bleacheries, Dyehouses, Paper Mills, Laundries

ALBERGER CONDENSOR CO.

140 Cedar Street, NEW YORK CITY

Agents: CANADIAN FAIRBANKS CO., Limited
Montreal, Toronto, Winnipeg, Vancouver

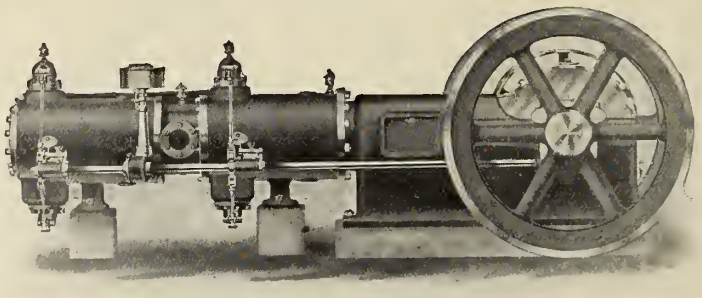
Type E.S.T.

--NOTICE THE CROSSHEAD--

Gas Engines for Perfect Regulation

Built like High Grade Steam Engines

Single and Double Tandem. A power impulse every stroke.



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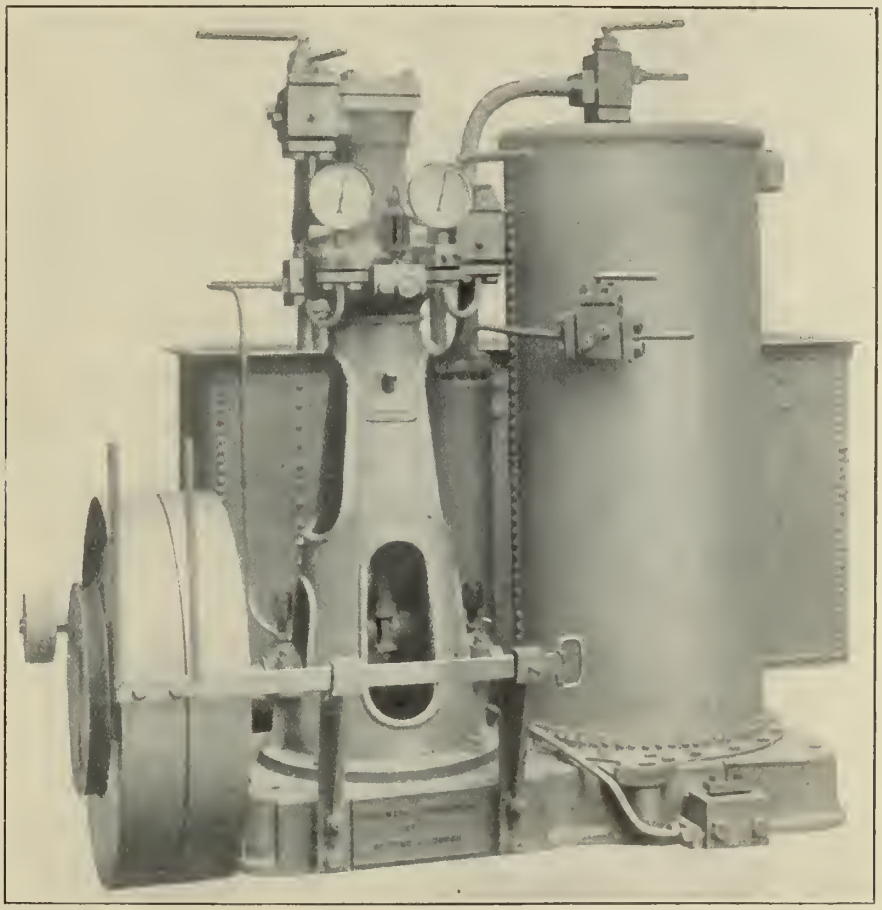
OF ALL CAPACITIES



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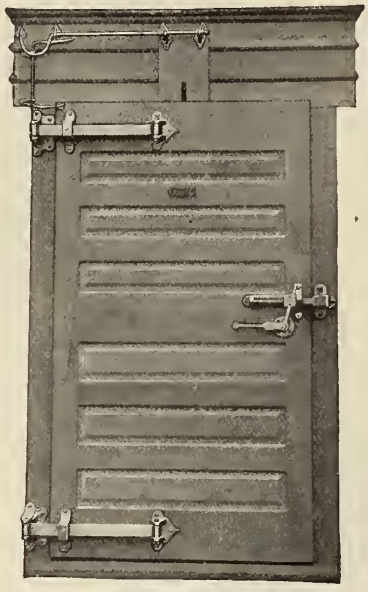

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So does the plant.

IF an engineer does not keep up-to-date, how long does it take to look elsewhere for a position?

IF the steam plant of any company or corporation is not up-to-date, how long does it take to find a leak?

These are not conundrums, but facts which confront us all.

The Heat and Pressure Control Co.

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Don't fail to consult if you wish to be up-to-date in money-saving appliances.

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Ice-Making and Refrigerating Machinery

SUPPLIED AND INSTALLED ON

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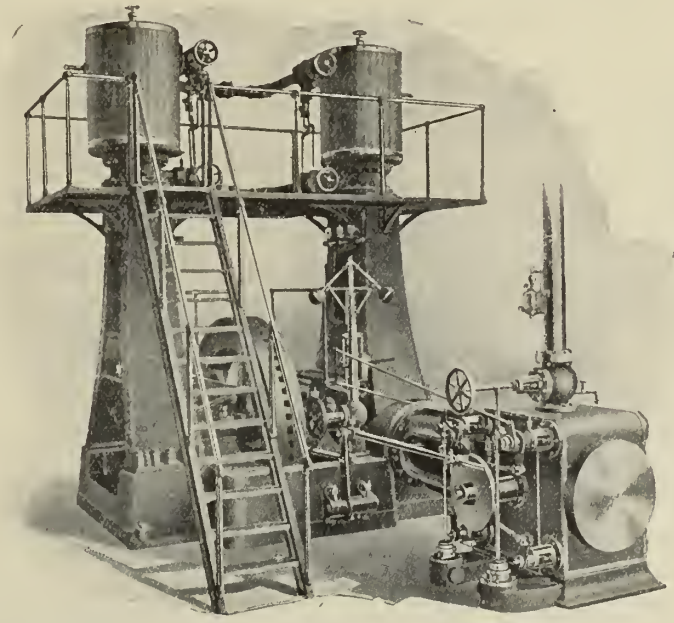

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NONPAREIL CORKBOARD INSULATION

For Cold Storage Buildings, Packing Houses, Abattoirs, Dairies, Refrigerators, etc. Also

NONPAREIL CORK PIPE COVERING

For Brine and Ammonia Pipes, etc. And

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REFRIGERATING ENGINEERS

MONTREAL, P. Q.

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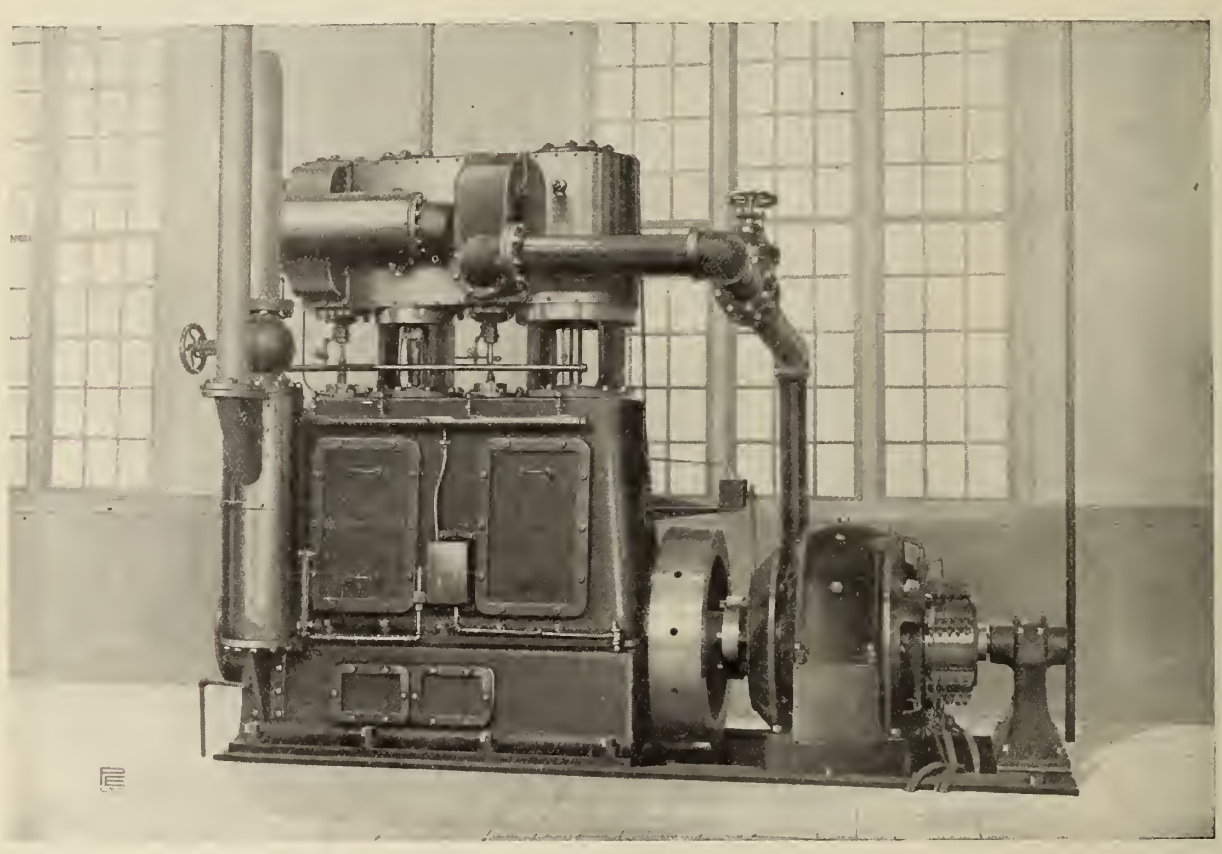
COMPOUND AND TRIPLE EXPANSION DESIGNS

IT PAYS TO DEVELOP YOUR OWN POWER

SPECIAL FEATURES

Small Floor Space Required. Simplicity of Design. Self Lubricating System. Silent Running and Lack of Vibration. Built Throughout for Durability. All Working Parts Easy of Access. Efficient Governing. Economical in Up-keep. Requires Minimum of Attention. Steady Service all the Time.



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When building or remodelling your steam plant, ask us for our Catalogues and Prices on Engines, Boilers, etc.

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The advertiser would like to know where you saw his advertisement—tell him.

The Plant and Equipment of the City Dairy Co., Ltd., Toronto

By H. A. Wilson

The subject as treated by the writer shows in a vivid, compact and comprehensive manner to what extent, enterprise and effective management of a large utility corporation can win its way into the confidence and retain the respect of the inhabitants generally of a great and progressive city. One has only to go back to the early days of July, a year ago, to realize how important a factor such institutions as the City Dairy become in the life and comfort of a community.

LIKE a great many other firms, which are large consumers of power, the City Dairy management have dispensed with the use of their steam machinery units, and have adopted electric motive power instead. This latter they consider to be not only cleaner and equally effective for their purpose, but in addition, more easily operated. The steam engines, however, are still kept ready for service, as well as the boilers; the latter doing regular duty in supplying steam for heating the buildings, washing cans and bottles, and for the pasteurizing equipment.

The business of the company has assumed such large proportions, that recently an addition almost as large as the original building became necessary. The ice cream department occupies almost the whole of this new wing. A small bakery is also located in this section, while in the basement is to be found one of the can ice-making equipments, as also the new ice crusher.

Refrigeration System.

The refrigeration system of the plant consists of two ammonia compressors connected to one common condenser. The ammonia gas, after being expanded in tanks of brine, is pumped through coils in a bunker room, the air of which, after being cooled, is delivered to the different storage rooms by two American Blower Co.'s fans of 30 and 36 inches diameter, direct-connected to motors. The Toronto Electric Light Co. supplies the electrical current, and all motors are 500-volt, D. C. machines. The lighting is 250 volts.

The engine room is situated on the ground floor of the north or old wing. The smaller compressor is a 40-ton, two cylinder, horizontal machine, supplied by the Linde British Refrigerating Company, Montreal. It is driven at a speed of 75 r.p.m. Formerly there was direct-connected to this machine a Goldie & McCulloch, Galt, Ont., 75 h.p. Wheelock engine, having a 12-inch diameter by 36-inch stroke cylinder. The engine was usually run non-condensing at a speed of about 75 r.p.m. The connecting rod and eccentric rod are now disconnected, and the unit is held as an emergency reserve. The compressor is now belt connected to a 60 h.p. D. C. Canadian General Electric Company motor, operating under 500 volts. The motor is of variable speed type, the limits being between 325 and 650 r.p.m—to run the compressor, 75 r.p.m., the motor is usually operated at about 450 r.p.m.

The other compressor is a 40-ton, two cylinder vertical machine, direct connected to a single cylinder slide valve steam engine; the complete outfit having been supplied by the Wegner Machine Company, Buffalo, N. Y. The steam engine is a 75 h.p. unit, the bore of the cylinder 14 inches, the stroke 14 inches, and the speed about 80 r.p.m. The engine was run non-condensing, but is also now disconnected, and a 70 h.p. Canadian General Electric D. C. motor drives the compressor at about 90 r.p.m.

The City Dairy Co. Plant, Toronto.—The Milk Room, Showing Holding Vats, Centrifugal Clarifier, Pasteurizers, Matthews' Gravity Carriers, Bottle Filling and Capping Machines, Washing Room, Etc.

The motor is also a variable speed machine operating under 500-volts at about 450 r.p.m.

The old lighting unit is still in the engine room, and consists of a Canadian General Electric Co. D.C., 125-volt, 75-k.w. generator, direct-connected to a Waterous Engine Works Co. 140 h.p. McEwan engine. The speed at which the combined apparatus ran was about 250 r.p.m. The stroke and bore of the engine, which operated non-condensing, are each 14 inches. The pipe coils of the condenser, carrying the compressed ammonia gas, are double, consisting of 1¼ inch pipe inside, and 2-inch pipe outside, and the total length is about 2,000 feet.

The Boiler Room.

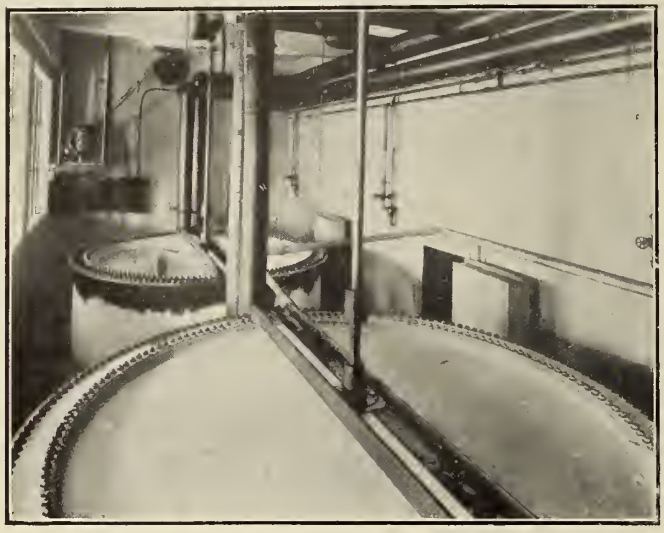
The boiler room is situated in the basement of the old wing, there being a battery of three return tubular boilers of 125 h.p. each, built by the Polson Iron Works, Toronto. They have each a grate area of 25 sq. feet, are fired by hand, and operate under natural draft. Smoke consumer apparatus forms a part of the equipment. Each boiler contains 86 tubes, 3½ inches diameter by 20 feet long. The boiler feed is taken care of by a Northey 8 x 6 x 4 pump. The working pressure is 90 lbs.

The stack of brick, hexagon cross section, is 115 feet in height; the diameter at the base being 10 ft. 0 in. outside by 5 ft. 0 in. inside, and at the top, 5 ft. 0 in. outside by 3 ft. 6 in. inside.

The Milk Department.

The milk is received from the farmers on the ground floor of the old wing. Each can, after passing two inspectors, is emptied into a glass-enamelled tank, from which it is pumped through sanitary piping to glass-enamelled storage tanks upstairs. Here it is out of contact with the air, and remains so until it arrives at the bottle-filling machines. Meanwhile, the cans pass along Mathews gravity carriers to the washing machines. From the glass-enamelled storage tanks, the milk falls by gravity to a large centrifugal clarifier, where all foreign matter that cannot be removed by straining is separated. The milk is next pumped into an internal tube pasteurizer. When flowing through this inner tube of German silver, it is heated to 180 degrees F. by water flowing through the outer tube. The temperature is regulated by an automatic temperature controller, and is graphically recorded by means of a Bristol recording thermometer. From the pasteurizer, the milk flows to an enamelled holding tank, where it is held at the pasteurizing temperature for 30 minutes. The milk pasteurizing equipment has a capacity of 1,200 Imperial gallons per hour.

The construction of this tank is rather unique. It consists of eight separate tanks arranged in a circle. Two revolving pipes, one an inlet and the other an outlet, automatically fill and empty each contained tank once every thirty minutes, the milk passing down to an internal tubular cooler. Here it flows through internal German silver pipes, and is cooled by water and brine in the outer pipe to about 36 degrees F. From the cooler, the milk passes through



The City Dairy Co., Toronto—Cream Holding Room.

The City Dairy Co., Toronto.—Packing Room, Ice Cream Dept.

The City Dairy Co., Toronto.—Engine Room, Old Wing.

The City Dairy Co., Toronto.—Engine Room, New Wing.

nickel-plated copper tubing to a strainer, and thence to automatic bottle fillers and cappers. Crates, containing one dozen empty bottles each, are fed into these machines by Mathews' gravity carriers, and automatically filled and capped. The gravity carriers then carry the crates of filled bottles to the bottle storage room, where the temperature is maintained at 34 degrees F. From the storage room they are delivered to the wagons, and finally to the consumer.

matic bottle-washer. The bottles are not removed from the crates for this operation.

The automatic washer consists of five tanks, each one of which is operated by a force pump. The cases containing the bottles are inverted, and enter the washer on a metal retainer. In the first tank they are rinsed out by lukewarm water; in the second, they are rinsed with warmer weater, containing an alkali powder, and in the third, the water is still warmer, and mixed with

churns in this section, with a capacity of 750 lbs. at each churning. The busy season is in summer, and then the daily output averages about 1,700 pounds, while as much as 2,800 to 3,000 pounds have been turned out.

Ice Cream Department.

The ice cream department is over in the new or south wing, and one can readily appreciate the proportions of this branch of the business when practically the whole of this new wing is given up

The City Dairy Co., Toronto—Engine Room, New Wing.

The City Dairy Co., Toronto.—Engine Room, New Wing.

Can and Bottle Washing and Sterilizing.

As the milk is removed from the cans, the latter are placed on the gravity carriers, and travel to an automatic can-washer. Here they are first rinsed, then thoroughly washed, afterwards being sterlized with live steam, rinsed again in boiling water, and finally dried with sterilized hot air at about 220 degrees F. The can lids undergo similar treatment in a separate machine.

As soon as the empty bottles in the crates are returned by the drivers, they are all checked and passed to an auto-

it is a purified washing powder. The water is still warmer in the fourth, and in the fifth they are sterilized with fresh hot water at 220 degrees F., and are then dried by a steam jet. From here, the bottles pass into the bottling room, where they are inspected, after which they go to the automatic cappers and fillers once more.

Butter Department.

The present butter department is on the ground floor of the old wing, but it is shortly to be moved to new quarters above the milk rooms. There are three

to it. The cream, received on the ground floor, is immediately put on an elevator and taken up to the third floor, where it is weighed, and allowed to flow by gravity to the two huge pasteurizers of 600 gallons capacity each. Large coils of pipe, through which live steam is caused to circulate, are oscillated in these pasteurizing tanks, until the temperature of the cream is raised to 145 degrees F. Hot water is then allowed to flow through the coils, and finally brine, until until the cream is cooled to 40 degrees F.

It is not necessary to hold the cream

The City Dairy Co., Toronto.—Plant as it appears from Spadina Avenue.

The City Dairy Co., Toronto.—Rear View of Ice Cream Dept.

at the pasteurizing temperature for any great length of time to thoroughly pasteurize it, as in the case of milk. From the pasteurizers, the cream flows into glass-enamelled storage vats on a lower floor. There are five pairs of these vats, each pair in a small separate room, suspended from the ceiling. The air in these rooms is kept at 40 degrees F. From these storage tanks the cream flows into two large mixing vats, where it is mixed with the syrup, composed of milk and sugar. In these mixtures, the revolving paddles cause three distinct currents. The outer paddles cause the cream to flow in one direction; the inner paddles, in the other, and paddles at the bottom cause an upward flow. Thus, the syrup and cream are thoroughly mixed. These mixing vats are also glass-enamelled. From these mixers, the cream flows down to the next floor to the freezers, where the flavoring is added. The freezers are cooled by circulating brine, and the paddles are connected by gears to a motor-driven line shaft. The cream is then placed in portable vats and transported to a room where the temperature is about 40 degrees F. Here it is put up in various forms of bricks, being afterwards removed to the storage room, where the temperature is kept at average of 5 degrees F. The brick rapidly hardens, and remains here until ready to be delivered to the consumer.

The City Dairy Co., Toronto—Ice cream freezers.

In this wing, a great deal of new apparatus is being installed, and, as yet, it is hardly possible to form a true estimate of the completeness of this department in the near future. One new machine, to be installed on an early date, is a vanilla pulverizer. This is being imported from Cincinnati. In it the vanilla bean is pulverized, and mixed with the sugar to make the syrup, doing away with the use of the vanilla extract. The company will import the vanilla bean in large quantities from Mexico.

The Bakery.

On the second floor in the south end of the new wing is located the bakery. Buns and rolls are made here, also ice cream cones. There are two patent machines for baking these ice cream cones. The dough is placed in a small hopper, and emerges from the machines as an ice cream cone, which, upon exposure to the air for a brief period, becomes crisp and ready for use.

Can Ice-making Plants.

In the basement of the new wing is located one of the two can ice-making plants. Both of these are alike, each having a daily capacity of ten tons. These plants only supply about fifty per cent. of the ice required during the rush season. Their united daily capacity can be increased to 22 tons, but if more than this quantity of ice is manufactured, the efficiency is found to be very materially decreased. The plant consists of a large brine pit, to which the brine is pumped by a direct-connected motor-driven turbine pump; the cans of fresh water being immersed in the brine. The latter is caused to circulate in the tank by an agitator driven by a vertical-shaft motor, direct connected. After, the cans are removed from the brine by means of a small traveling crane, they are momentarily exposed to a steam jet, after which operation the ice is readily removed and passed into the crusher.

At present, a new crusher is being installed, with a capacity of one ton per minute. The ice is discharged from this crusher to a conveyor, which is simply a moving floor constructed of steel plates. Upon leaving the conveyor, the ice is deposited in the pockets of an elevator especially designed for this purpose. From the elevator, the ice is discharged into a hopper, the bottom containing a device by means of which the contents may be carried outside for loading into wagons, or being conveyed to the room where the bricks and cans of ice cream are packed in tubs for transportation to the various customers.

The brine used in the cream pasteurizer and brine pits is circulated by four centrifugal pumps. One of these is situated in the old wing, and is direct-connected to a 15 h.p. motor. There are three others in the new wing, also direct-connected to motors of 10, 7½ and 3 h.p. respectively.

Engine Room New Wing.

In the new wing, the engine room is located in the basement. There are two vertical compressors driven by Canadian General Electric D.C. motors. Both compressors were supplied by the Wegner Machine Co., Buffalo, N.Y., and are two-cylinder vertical machines of 40 tons and 60 tons capacity respectively. The smaller compressor is belt connected to a variable speed 60 h.p. D.C. motor while the larger is similarly connected to a 70 h.p. motor. The motors are of a similar type, differing only in regard to power. Their range of speed is from 340 r.p.m. to 650 r.p.m. Usually they are operated in the neighborhood of about 450 r.p.m., which speed drives the compressors at 75 r.p.m. The floor and walls of the engine room are constructed of concrete, and are a model of order and cleanliness.

General.

The company maintains a very complete chemical laboratory, where analyses samples of all milk and cream delivered to the dairy are made. Any not up to standard are, of course, rejected. Thus, there is eliminated any possibility of an inferior quality of milk and cream being delivered to consumers.

Several carpenters are employed the year round to keep crates, boxes, ice cabinets, etc., in good repair, and when the ice cream season is slack—during the winter months—a number of the men are employed, painting and cleaning, and caring for the equipment generally. This system ensures a full complement of experienced men to handle the increased trade to advantage when the busy season again comes round, and does away with the trouble and expense of training new men.

Another section that in no way should be overlooked, is the tinsmithing department, where several tinsmiths are kept constantly employed manufacturing and repairing milk cans.

The employees are required to wear white suits during working hours, and the company maintain their own steam laundry, where these uniforms are washed and sterilized.

The lavatories, of marble throughout, steam-heated and equipped with shower baths, compare equally with those found in the best hotels. Every inside employee has a metal locker, and a very pleasant and attractive lunch and smoking room adjoins the locker room. When the new machinery and apparatus is installed, there will be very few institutions in Canada following dairy pursuits to compare with the City Dairy Company, Limited, of Toronto.

"Flooded" Freezing Systems*

By W. M. Morris.

THE flooded system applied to freezing means simply a bottom feed for the tank coils with an accumulator, or, properly speaking, a separator on the suction line trapping back to the coils any liquid which is carried over in the suction line. This operation might be compared to a separator on the steam line located high enough to trap back to the boiler any water which would be carried over with the steam, excepting that, in the case of the steam separator, only the priming is taken care of by the separator, and in the case of the accumulator a large amount of liquid flows over; in fact there is a continual travel of the whole mass of liquid in the coils. Gas bubbles, generated in the various parts of the coils, are being pulled by the suction of the machine, and not being able to pass a slug of liquid just ahead, push it along until the whole body of liquid is moving rapidly through the coil.

The amount of liquid which is carried over to the accumulator, can, in a properly constructed system, be regulated by the feed valve so that practically all of the liquid is evaporated by the time it leaves the tank coil. With this arrangement, it is also practicable to operate as a "dry gas" system should the operator desire to do so, for in introducing the flooded system, builders have not made any radical changes in their standard equipment, but have simply changed the manner of feed and control of the ammonia.

Adaptation and Application.

This system is adapted with varying degrees of success, to almost any kind of coil arrangement in freezing systems, but shows the greatest efficiency in a vertical coil. A great many people are using the system successfully on oval coils, with a header top and bottom, and while the tank would not be considered running strictly "flooded," an increase of something like 10 per cent. in capacity has been shown in several installations of this character.

The strictly horizontal coil can only be benefited in so far as the application of the accumulator or separator would take care of a slight rush of liquid and which would permit of a denser gas in the coils; thus trapping back to the coils any liquid which would be carried over, and giving the operator a better chance to regulate his feed to the maximum without carrying too much liquid over to the machine. The flooded system is not only being applied to freezing systems but is used on brine coolers and on storage room coils. It is especially adapted to sharp freezers and ice cream hardening rooms.

The average man who is not familiar with this equipment is inclined to think it complicated and dangerous, but to the contrary, it is simplicity itself. A very little more ammonia is required than in a standard "dry gas" system, and we are only applying the same principle on the low pressure side of the system which has always existed on the high pressure side, viz.: a question of pressure and temperature, as, for example, with 75 degrees water leaving the ammonia condenser we have a corresponding pressure of 127 pounds; if 60 degree water 93 pounds; if 40 degree water 60 pounds, and so on; therefore, if we have 10 degree brine and 25 pounds back pressure, we have a condenser instead of an evaporating coil. If we speed up the machine and pump the back pressure down to 15 pounds, with the same tank temperature, we have a very vigorous boiling of the ammonia, thus an evaporating coil instead of a condenser.

Increased Efficiency of Coil Surface.

The efficiency of the coil surface is increased something like 75 per cent. by running "flooded;" therefore, much less pipe is needed in the tank to do a given amount of work, and it has been found by experiment that from 180 to 200 feet of 1¼-inch pipe per ton ice-making capacity is sufficient; in fact an excessive amount of pipe in a flooded system is a drawback instead of a help, for the amount of pipe surface specified above will evaporate as much gas in a machine of the same capacity as the tank will handle, and more pipe would necessitate a larger machine, which would again mean too cold a tank and a call for more cans; thus you would have a larger plant throughout.

The old standard "dry gas" plant converted into a flooded system and properly equipped, with the proper brine circulation, usually shows an increase of from 15 to 25 per cent. in output. This is on account of the increased efficiency of the coil surface. Every foot of pipe in the tank is forced to work to its maximum, and with the same back pressure on the machine, a colder tank temperature can be carried; the increased efficiency of the coils making it possible to do the necessary refrigeration with a range of about 5 per cent. between the temperature of the ammonia in the coil and the brine in the tank, instead of 10 per cent. as is the usual custom.

The success of a properly designed flooded system is beyond question, whether on a new plant or applied to an old one, and this fact is brought more forcibly to view when I state that the company whom I represent has not sold a single "dry gas" system for almost three years, besides changing over many old plants.

*Abstract of Paper read at the 22nd Annual Convention of the Southern Ice Exchange, Tampa, Fla., February, 1912.

PHYSICS OF REFRIGERATION.

DR. P. H. BRYCE, chief medical officer, Department of the Interior, Ottawa, read a paper recently before the Ottawa Engineering Society on the "Physics of Refrigeration," in which he discussed the fundamental principles of refrigeration and insulation, and drew attention to the importance of having all foods in first-class condition before placing them in cold storage.

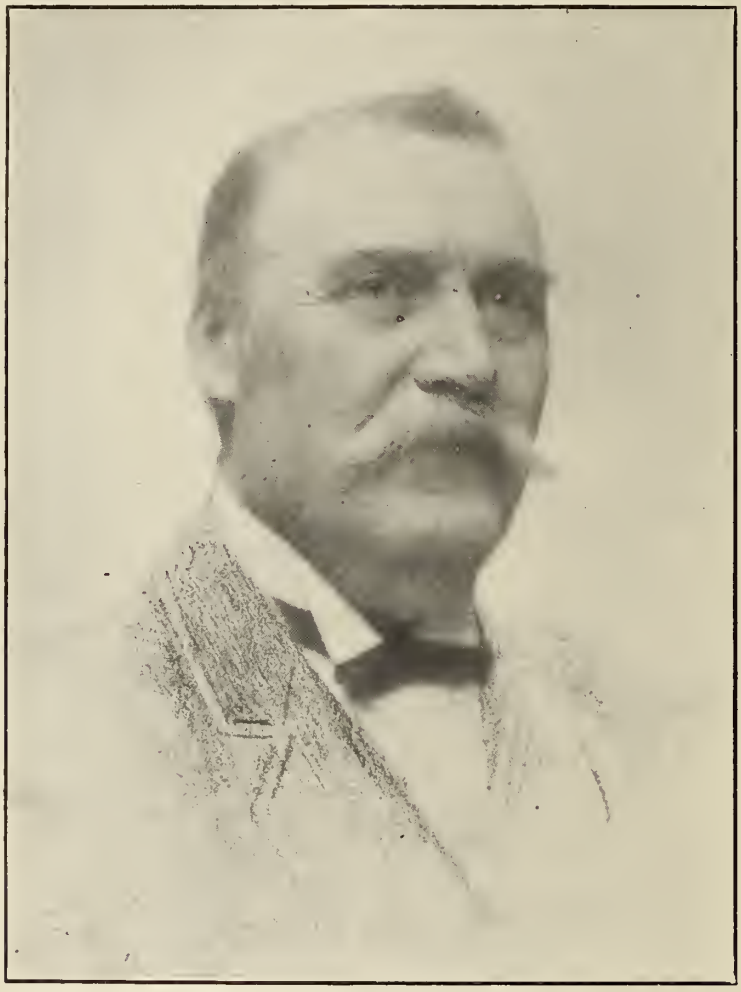
"Hitherto this is where a fatal mistake has often occurred, and until the producer and trader become interested equally with the owner of the cold storage warehouse, the efforts of science will be but partially successful." The advantages of precooling were also outlined, and the importance of ventilation in the warehouse and necessity for proper attention to relative humidities urged. Mr. Bryce deprecated the almost total lack of skilled refrigerating engineers in Canada. I do not know of more than two men in Canada who are refrigerating engineers as specialists, and I am not aware of any technical school which has any course on the subject, and but one in the United States and one in England."

"Ice and Refrigeration," in commenting on the foregoing remarks, says that "Mr. Bryce was probably not aware of the efforts that have been made and are being made by the American Association of Refrigeration to secure the inauguration of thorough courses in refrigerating engineering in the universities and colleges of the United States, and of the fact that several of the higher institutions of learning have already added courses on refrigerating engineering, more or less complete, to their curricula. The insufficiency of such facilities is still.

however, glaringly apparent, but there is now prospect of considerable improvement in this direction in the near future.''

THE LATE MR. W. T. BROWN.

WE regret to have to record the death of Mr. W. T. Brown, one of Canada's prominent and successful sons in the realm of mechanical engineering; the unlooked-for event having taken place on February 9, at his home in Galt, Ont. On previous occasions due to periodical breaks in their ranks, we have been called upon to refer to the large part such men as the late John Dyer, Thomas Pringle, Walter Laurie, Edward Lamb and J. C. Weir have played in the development of mechanical engineering activities and successful undertakings, and to these must now be added the name of Mr. W. T. Brown, who for nearly a quarter of a century has been connected with the engineering department of the Goldie & McCulloch Co., Galt, Ont., during which long period he had won and retained the confidence and respect not only of his employers, but that of all with whom he came in contact in both a business and social capacity.



THE LATE W. T. BROWN, OF GOLDIE & McCULLOCH, LTD., GALT, ONT.

Mr. Brown was born in Toronto in the year 1846, but when quite young, moved with his parents to Bowmanville, where he served his apprenticeship with Meads & Son, founders and machinists. On completing same he returned to Toronto for a short time, after which he went to Oshawa, where he was a valued employe for a number of years of F. W. Glenn. It was in Oshawa that he met Miss Annie Davey, to whom he was married in 1867. They resided in Oshawa until 1874; leaving for Ottawa in that year when Mr. Brown became superintendent of the waterworks. In 1880 he moved to Cleveland, Ohio, where for two years he was superintendent in the machine shop of the Cleveland Rolling Mills. In 1882 he and a partner went into business in Carleton Place, which business was later moved to Dresden, In 1886 he disposed of his interest in the partnership and came to Hamilton where he was superintendent of the Beckett Engineering Co.'s works.

It was in the year 1889 that he accepted a position with the Goldie & McCulloch Co. of Galt, with which firm he remained until his death. During the first few years of his connection with the Goldie & McCulloch Co. he acted as traveling representative and superintendent of erection. He was later made their mechanical engineer, and for the last six years has acted as their estimating engineer. He left his desk on the eve of February 9, in his usual health, and in less than an hour had gone to his reward; his very sudden death being due to heart failure.

Mr. Brown was a true friend, a man of sterling integrity and greatly beloved by all who knew him. He was a great reader, a deep thinker and keen student of nature. His wife predeceased him about five years ago, while a son and two daughters survive to mourn the loss of a good father.

THE HARE ENGINEERING CO., LTD.

THE Hare Engineering Co., Toronto, have been incorporated with an authorized capital of $400,000. The officers of the new company are, W. Almon Hare, B.A.Sc., president and managing director; W. D. Sheldon, of Sheldons, Ltd., Galt, Ont., and A. Alfred Laurie, secretary-treasurer. The assets of the Standard Engineering Co., of Toronto, have been purchased, and it is proposed to erect a machine shop and foundry at Galt, Ont., in the near future. The head office of the company is at 14-16 King Street East, Toronto.

Manufacturing rights for the Dominion of Canada have been secured on mechanical stokers, coal and ash handling machinery, steam turbines, steam specialties, steel heating furnaces, rolling mill equipment, etc., all of which appliances were previously manufactured and sold by the Standard Engineering Co.

An exceedingly favorable and valuable manufacturing site, consisting of six acres of selected level land, has been secured at Galt, the property being served by the tracks of the Galt, Preston & Hespeler Electric Railway Co., which connects with both the Canadian Pacific and Grand Trunk Railway Systems. Plans are already prepared for the layout of a complete plant, the design and arrangement being a result of careful investigation of the most modern ideas and equipments installed in both the United States and Canada for purposes similar to the company's proposed lines of manufacture.

If you have done little and worked hard, you have done more than if you had accomplished more and worked less.

The fellow who thinks that his job is unimportant usually gets just that kind.

An irresponsible position in a power plant may save you from a disagreeable call-down, but it will never make you an engineer.

Refrigeration and Cold Storage Practice Features

By E. J. Greenstreet, F.R.A.I.C., Toronto

The writer of this article is an expert in the profession of Refrigeration and Cold Storage. His work has brought him into close touch with the various mechanical and architectural problems to be met and solved. Such opinions and conclusions, therefore, as are given expression to throughout the paper may be accepted as indicating in a real sense the importance of those interested being thoroughly alive to the requirements which make for economy and commercial success.

ACCORDING to a list published in the February number of "Ice and Refrigeration," ice making accounted for just one-half of the total amount of refrigeration installed in the United States during the year 1911. The following are some of the figures, from which it will he seen that out of a total of 43,450 tons of refrigeration installed for all purposes, 21,940 tons were applied to the manufacture of ice.

Ice making	21,940	tons	refrigeration
Breweries	6,126	"	"
Oil refineries....	2.590	"	"
Cold storage warehouses ..	2,207	"	"
Packing houses..	1,353	"	"
Creameries	1,208	"	"
Hotels	1,171	"	"
Varions	6,855	"	"
Total	43,450	"	"

Artificial vs. Natural Ice.

In the development of the business in Canada, it is hardly likely that such a large proportion of the refrigerating plants installed will be used for the manufacture of artificial ice. Mr. Madison Cooper, in his book on cold storage, maintains that "expensive steam driven machinery cannot successfully compete with God Almighty and a Minnesota winter in creating refrigeration." Mr. Cooper may be right as regards the actual production of refrigeration, but there are many other points to be taken into consideration. Even in Canada, where vast quantities of refrigeration are stored up hy nature in the form of ice during the winter months, we find it impossible to apply such refrigeration just when and where we need it during the summer months.

Again, as regards the production of ice, it is probable that there are certain parts of this country where artificial ice may be manufactured and sold in successful competition with the natural product. Nature certainly does the work of refrigeration very eheaply, but other factors have to be taken into consideration when determining the value of the two articles—the natural and the artificial product. The question of the purity of the two different kinds of ice has been much discussed, and a good deal has been said ahout the action of freezing tending to throw out impurities from the water, but this, of course, would apply to natural as well as to mannfactured ice by the "plate system." With ice manufactured on the "can system," it is possible, by using distilled water, to control the quality. There is no doubt it is possible to obtain natural ice, which is perfectly pure and wholesome, but it is sometimes necessary to go considerable distances from large centres of population in order to obtain it.

Cost of Manufactured Ice.

When comparing the cost of artificial ice with the natural product, there are quite a number of points to take into consideration. In the case of natural ice, although no "expensive steam driven machinery" is required to produce it, the cost of harvesting, transporting, handling and storing has to be reckoned. To these items must be added the loss hy meltage during the season's storage, and in a poorly constructed ice house the loss from wastage may run as high as 20 per cent. or even 25 per cent.

It is just as difficult to arrive at the cost of artificial ice, and many misleading statements have been made as to the price at which it can be produced. Power, lahor, water, etc., and also interest and depreciation on cost of plant and equipment, must be taken into account. The scale upon which the manufacture of artificial ice is conducted has also a very important bearing on the cost of production. Without going into details it may be stated in a general way that with average working costs for power, labor, etc., and allowing a fair margin for depreciation, it is necessary to manufacture on a large scale in order to turn out artificial ice anywhere in the vicinity of $1.25 or $1.50 per ton.

Cold Storage.

Probably the most extensive application of refrigeration in Canada will be to cold storage warehouses for storing various articles of food such as meats, fish, eggs, butter, fruit, etc. In order to apply refrigeration successfully to cold storage buildings many points have to be taken into consideration. One of the first things to decide is the amount of refrigeration necessary for a given work, or in other words, the size and power of the machinery required. In refrigeration, all calculations are based on the British thermal unit, and given all the conditions under which a plant has to operate, it is possible to calculate closely the amount of refrgeration required. These detailed calculations were dealt with in a previous article in The Power House. As a matter of fact, it very often happens that all the conditions cannot be definitely stated, and in such cases it is customary to arrive at the size of the plant by assuming data based on actual experience of average working conditions.

In the case of cold storage warehouses, for instance, quite a usual method is to allow one ton of refrigeration to a given number of cubic feet of cold storage space. Tables have been compiled showing the number of cubic feet of space which can be covered by one ton of refrigeration in buildings of varying sizes, for temperatures of varying degrees, and also for insulation of different qualities. Naturally the number of cubic feet of space covered by one ton of refrigeration in 24 hours varies greatly. In small buildings, for instance, with poor insulation, and where low temperatures are required, the number of feet of space covered by one ton of refrigeration will be very small, perhaps not more than 2,000 or 3,000 cubic feet. On the other hand, in large buildings with good insulation, one ton of refrigeration could take care of, say 6,000 or 8,000 cubic feet of space.

Low Temperatures.

The temperatures required in cold storage warehouses may be divided into two classes, high temperatures and low temperatures. These terms, of course, are only relative and used for convenience in discussing cold storage work. Low temperatures are required for freezing and storing fish, meat, butter and poultry. The lowest temperatures employed are for freezing fish, the rooms used for that purpose being reduced to 10, or even 20 degs. below zero Fah. Butter is now very frequently stored at a temperature well helow zero. Provided there is ample refrigerating power, a liberal allowance of room piping and thoroughly well insulated rooms, low temperatures give less trouble than the higher temperatures required for eggs, fruit and the more delicate kinds of produce which have to be kept ahout the freezing point of water, or slightly above.

Low temperature rooms are generally cooled by means of brine pipes or direct expansion piping placed in the rooms to be refrigerated. The quantity of piping employed to distribnte the refrigeration is generally arrived at in much the same way as the refrigeration itself is calculated. The amount of piping is proportioned to the cubic contents of the room, and tables have been compiled giving the number of cubic feet of cold storage space, which can be refrigerated by one lineal foot of piping of a given

size. In this case, also, we have a varying quantity depending on the temperatuer of the room, the size of the building and on the quality of the insulation. Sharp freezers for fish, for instance, where very low temperatures are required, and quick application of refrigeration necessary, are sometimes piped in the ratio of two lineal feet of 1 or 1¼-inch direct expansion piping to one cubic foot of space in the room. Storage rooms for holding hard frozen produce at temperatures from 5 to 15 degs. above zero Fah. do not require more than about 1 lineal foot of 2-inch direct expansion piping to 6 or 7 cubic feet of cold storage space —that is in large buildings with good insulation.

High Temperatures.

In high temperature rooms, rooms for the storage of eggs, cheese, fruits, vegetables, etc., the actual refrigeration required is, of course, less; but at the same time, other problems have to be reckoned with besides temperature. For one thing, the article stored at these higher temperatures is generally very sensitive, and one or two degrees variation may make all the difference to the quality, particularly in the case of long storage. With hard frozen produce, a few degrees one way or the other will not make much difference. In the case of hard, frozen meat, for instance, it does not matter very much whether the room is held at a temperature of 10 degrees or 15 degrees, as no great harm will result. With eggs, however, which are generally kept round about a temperature of 30 degrees Fah., any such variation, one way or the other, would be fatal. At these higher temperatures, too, the questions of moisture and ventilation present problems far more difficult to deal with than is the case with low temperature rooms.

Considerable difference of opinion exists among cold storage men as to the best method of applying refrigeration to high temperature rooms. Some advocate a system of air circulation and are opposed to placing pipes, either brine or expansion, directly in the rooms. Others again, favor a system of room piping used in conjunction with some method of air circulation. In any case, it is necessary if the best results are to be obtained, to make some provision for changing the air, and dealing with the moisture and gasses given off by nearly all produce kept at comparatively high temperatures.

Construction of Buildings.

The arrangement and construction of buildings for cold storage purposes are of the utmost importance if successful results are to be obtained. However good the refrigerating machinery, and however skilfully operated, satisfactory results will never be obtained unless the buildings are properly constructed and thoroughly well insulated. In this connection, it may be said at once that the cold storage building is an expensive class of construction. Probably more trouble has been caused in cold storage work, owing to faulty construction and imperfect insulation than has been caused by difficulties with the machinery. One reason of the comparatively high cost of cold storage buildings is due to the exceptionally heavy weights placed upon the floors. The usual loads that should be allowed for in cold storage warehouses range from about 225 to 400 pounds per superficial foot of floor surface. Insulation is also an expensive item, for, unless properly insulated, a cold storage warehouse will never give satisfactory results. To some extent, inferior insulation may be offset by the application of greater refrigerating power. That means, however, increased working costs and is generally false economy in the long run.

The conditions under which cold storage buildings operate are particularly unfavorable for ordinary wooden construction. Unless very carefully constructed, the life of a wooden building, or even a brick building, containing a considerable quantity of lumber in its make-up, is comparatively short. There is not the least doubt but that many of the cold storage buildings in Canada and the United States have already reached their life limit. In such cases, a continual yearly expenditure is necessary in order to keep the premises in repair. Portions of the building and insulation have to be renewed continually. Sooner or later such warehouses will have to be rebuilt, and must give way to buildings of more modern and more permanent types.

The tendency is to erect large, modern cold storage warehouses of reinforced concrete, and for smaller buildings, some form of mill construction is generally adopted.

Insulation.

Modern insulation is nearly always of the solid type, being applied directly to walls, floors, etc., and generally finished with a coating of cement on walls and covered with a wearing surface of concrete in the case of floors. Air spaces or concealed spaces filled with some insulating material are seldom used now in modern cold storage warehouses, except in small and comparatively unimportant buildings.

There are several kinds of insulating material of the solid type suitable for direct application to walls, ceilings and floors. The two principal are cork board, and another material, also in board form, having for its basis mineral wool. These specially manufactured insulating products will transmit about four British thermal units per 24 hours per degree of difference between inside and outside temperatures for each square foot 2 inches thick. Numerous tests have been made, all of which vary, therefore, the figures given above are only approximate.

One very important point to bear in mind in connection with insulation, is the fact that nearly all tests published are made with perfectly dry material. Very different results are obtained when insulating material is charged with moisture. In actual practice, therefore, the question of resistance to moisture has to be taken into account, and it is always necessary to make provision for water-proofing and protecting the insulation from damp. The thickness of insulation used is generally proportioned to the temperature required in the rooms under cold air, and ranges from three or four inches of corkboard or similar material for high temperature rooms to 6 or 8 inches in the case of low temperatures.

In order to obtain the best results, the insulation should be considered when the building is designed, and provision made for applying it thoroughly and efficiently to the structure of which it forms a part. If this is not done, difficulties will be experienced, and unnecessary expense incurred.

The Refrigerating Engineer.

The engineer in charge of the refrigerating plant is generally expected to know something about a number of subjects quite outside the actual running of the machinery. He is responsible for the temperatures, and if anything goes wrong in a cold storage warehouse he usually gets the blame. For this reason he should be well posted as to the value and quality of the various kinds of insulating material, the temperatures at which the different kinds of produce should be stored, the right degree of humidity in the rooms, and the cases where air circulation and ventilation are advisable or necessary. He is often called upon to make changes or alterations to the system, or to fit up new rooms. He should, therefore, know the amount of refrigeration required for performing a given quantity of work, and should be able to reckon the amount of piping necessary to distribute that refrigeration properly. Where expansion piping or brine piping is placed directly in the rooms he should know the best position for that piping, and if the indirect system is required, he should understand the construction and arrangement of the necessary air ducts.

It frequently happens that a cold storage room is piped in such a way that very poor results are obtained, therefore, unless some attention is paid to the laws that govern air circulation, and the room piping arranged in such manner as to assist and not retard this process, the goods in the room will not be cooled as efficiently as they should be. It will be found that there is a very uneven temperature throughout the room, and if much moisture has to be dealt with, a considerable proportion will be deposited on the goods and on the walls, instead of on the cooling pipes. In the case of a room under air circulation, the engineer should certainly understand the best method of distributing air throughout the room and through the goods to be cooled.

A violent circulation of air through portions of the room, and little or no

circulation in other parts, is the most common fault where the indirect system is adopted. The results are naturally very bad, and it is just such cases of faulty application that have brought this scheme into discredit. A gentle circulation of air, evenly distributed throughout the room, will give good results even with the most delicate kinds of produce, and there will be no danger of excessive shrinkage of the goods even under a long period of cold storage.

Enough has probably been said to show that the refrigerating engineer in charge of an important cold storage establishment must be a pretty good all round man. In addition to the ordinary engineering knowledge necessary to run the plant and look after engines, boilers, electrical machinery, pumps, etc., he should know something about the other subjects touched upon in this article. It is a wide field and a very important one, and although I have dealt more particularly with cold storage warehouses, there are a number of other businesses where refrigerating machinery is required, and of which the engineer may be called upon to take charge, in conjunction with other apparatus. In breweries, packing houses, meat markets, dairies, oil refineries, hospitals, clubs, hotels, etc., refrigerating machinery will be found; it is well, therefore, to keep posted on all matters connected with the subject. In addition to actual practice, this can be done to a great extent by studying the few books on refrigeration that have been published, and by keeping in touch with the columns of those papers devoting space to the subject of refrigeration and cold storage.

WATER GAUGE GLASS PACKING HINTS.

By John Moncrieff.

SINCE the introduction of high pressure steam boilers, breakage of Gauge Glasses has caused much annoyance and given rise to numerous complaints. Many suggestions have been made of introducing substitutes, but the question arises, would the substitute be any better, and may the Gauge Glasses now in use (if of good quality) not be sufficient for all that is required of them? I am of opinion that they are, provided always that the quality is good.

We have made a large number of experiments with the "Perth" Gauge Glasses and find that these will stand a hydraulic pressure of five thousand lbs. per square inch without breaking. You may take one of them in your hand by one end and insert the other into a flame that will bring it to a red heat in about half a minute, without breaking.

Causes of Gauge Glass Breakage.

Such being the case, the question naturally arises, why should a glass that will stand the variation of heat above five thousand lbs. hydraulic pressure, be broken with two or three hundred lbs. of steam pressure? To this it might be replied that in the one case the tests are done separately, while in the other the heat and pressure are combined. This looks like a formidable objection, but it is only so in appearance, as I am quite sure we will be able to prove that the glasses are broken neither by the pressure nor the heat, but by the expansion of the glass being interfered with.

Increased pressure of steam means increased heat, and the heat and pressure combined means an increase in the expansion of the glass. If the glass is packed too tightly, or in any way to interfere with its natural expansion, breakage is unavoidable, for it must break the moment it reaches the point of resistance.

With regard to the packing of Gauge Glasses there are a number of points to be noticed; first, you must have a good gauge glass. There are glasses that will not stand two hundred lbs. pressure, pack them how you may. Again, glasses must not be too full for the size of the gland. More glasses are broken from this cause than would be credited, if the totals were known.

In the second place, the gauge cocks must be set perfectly true, otherwise the glass will have too little space for expansion on one side. Further, the packing must be suitable and of the very best quality. Rubber washers, even of first quality are not suitable of themselves, with steam at 200 lbs. or more, because they get softened to pulp in a very short time and are blown out. To prevent this they should have a ply of asbestos twine or cord on each side.

The next point to be noticed is the screwing up of the glands. You should be able to move the glass with your finger and thumb after the screwing is finished. If you cannot do so the room for expansion is not sufficient and breakage will result. With the glass left easy there will be a little leakage when the steam is put on, but this will take up as soon as the glass and packing expands. To insure perfect safety, however, it would be as well to slacken the nut almost to the leaking point again. One point to be particularly noticed is, that the glass breaks most frequently at the steam end of the gauge cock, that is because the steam is hotter than the water and causes more expansion. This should be kept in mind when screwing up the glands. If these directions are followed, a good Gauge Glass should stand perfectly well in the highest pressure boiler that has yet been made.

Gauge Glass Hints.

As a proper packing of a Gauge Glass is so important to engineers and stokers, especially where high pressure boilers are used, I take the liberty of formulating these hints into a kind of rule:—

First, a good Gauge Glass must be used, which should not be too full for the size of the gland; second, a good rubber washer should be used, protected by a ply of asbestos twine on both sides; and third, the glass should be movable by the finger and thumb after the glands have been tightened up. The steam end of the glass should be left a shade slacker than the water end, and in every case the steam should be turned on gradually; and last, but not least, the whole operation should be carried out with intelligence.

This last instruction is quite as important as any of the others. Experiments have been carried out on a steam boiler with a working pressure of three hundred lbs. At first there were a great many breakages, but experience showed what kind of packing was required, etc., making it afterwards almost impossible to break one.

ICE SUPPLY OF MONTREAL.

THE report of the Canadian Committee of the British Science Guild has just been submitted by Dr. Barnes, and amongst other things, takes up the question of supplying cheaper ice to the poor of Montreal. The report states that, owing to the excessive heat of the Canadian summer, an abundant supply of ice is absolutely necessary for the preservation of health of those forced to remain in the city.

Hitherto no attention has been directed to conserving the immense supply of ice produced during the winter months. Dr. Barnes pointed out in a lecture before the Montreal Canadian Club that there was probably no finer stretch of surface ice anywhere than on Lake St. Francis. A rough estimate of the value of this ice, which ranges from 24 to 36 inches thick, is five hundred million dollars, reckoned at city rates; enough to give every man, woman and child in Montreal one hundred blocks of ice per day for four months. Considering the presence of such a supply, it behooves the ice companies to harvest sufficient for the needs of the city.

The government has also been considering the advisability of supplying the municipalities with ice, and with this end in view, it has been suggested that in the absence of natural sources of supply, artificial ice-making plants be established. In the smaller towns, no plant would be erected, but large central ice houses would be located at points favorably situated for distribution.

The Manufacture of Merchantable Can Ice from Raw Water*

By George Braungart, Atlanta, Ga.

The subject of ice production from raw as distinct from distilled water is one becoming daily more prominent from a competitive business point of view, and the treatment of the question by the writer affords opportunity for those interested to weigh up the different propositions and take action as may best seem applicable to their individual equipments and conditions.

LET us consider a plant with a simple Corliss engine and the usual steam-driven auxiliaries; the owner wishes to cut down fuel expenses, so he compounds his engine, runs it condensing, installs an electric generating set, and replaces the steam auxiliaries with economical electrically-driven equipment. He has succeeded in cutting his steam consumption, and hence his coal bill, nearly in two, but with it also his supply of distilled water. In some isolated localities he could perhaps make up part of this shortage by admixture of raw water with his supply of distilled water, without affecting the quality of his ice, but with few exceptions, he is forced to install a raw-water freezing system, or an evaporator plant. These are somewhat expensive, and therefore, it appears as though he would be well repaid to investigate a raw-water plant, in order to determine whether it will fit his particular case.

Requisites of a Raw Water System.

The first requisite of raw water freezing system, next to ability to produce merchantable ice, is that it it is not too expensive to install, and that it does not require too expensive changes to the lay-out and general make-up of the plant. The only method with which I am familiar, and that fulfills these requirements, is what I shall call, for want of a better name, the "Air Blowing System;" with this, our company has had considerable experience and success. It consists of a standard freezing system, with standard cans, of any size or shape found in practice. The cans are filled by standard can fillers from a raw-water storage tank in which the raw water is pre-cooled by return suction gas. or direct expansion coils. Buried in the frame-work is a system of air headers and laterals, with an opening for each can. These openings have nipples screwed into the headers, and a small piece of hose is slipped over the nipple and over the ¼-inch pipe hanging in the can. The hole through the nipple is very small, being about 3-64 of an inch in diameter.

Compressed air, at from 4 pounds to 6 pounds pressure, is supplied to the air header system, and thence to the cans, by means of which a constant agitation of the water in the cans is maintained, with the result that the ice freezes out clear, just as the ice from natural bodies of water, in which the water is in motion and clear, because the surface of the ice while freezing is constantly being washed, the impurities being taken up by the unfrozen water. This explains why still water will not freeze out clear.

Before the ice has frozen up to where it would close around the air pipe, this latter must be removed, and the remaining unfrozen water in the can pumped out. The hole in the ice cake is then refilled with distilled water, which is frozen without air agitation, and the ice pulled and dumped in the usual manner. The amount of distillate required for filling the cans is usually from 10 per cent. to 15 per cent. of the total capacity of the plant, which amount can in all cases be obtained from the auxiliaries, and, of course, the distilling system need be no larger than this. I have found that in some cases where the raw water supply is good, a fairly good merchantable quality of ice can be obtained through refilling the cores with simply fresh filtered raw water, but in most cases, this will result in a heavy white core.

A peculiar feature of this system is that the length of the ¼-inch air pipe, or in other words, its submergence must be fixed so as to suit the conditions obtaining at each particular plant, the pipe being longer in some plants than others; and, of course, where a long pipe is necessary, the amount of water that will have to be pumped out and refilled into the cores will be greater than where a short pipe is found adequate. This difference is due to difference in the quality of raw water.

Difficulties and Troubles.

Where the raw water supply is good, and where the operation of the freezing tank receives proper care, this system will make excellent ice. The troubles to the operator arise in the failure of the tank labor to remove air pipes in time, or to remove them at all. In the former case it is necessary to thaw them out by means of a steam thawing needle, and where they are frozen solidly in the ice cake, they will give rise to considerable trouble in their removal. Another trouble is failure to install the air pipe in the first place, which will make a block of white ice and still another trouble is failure to suck out the raw water after removing the air pipe, or refilling with fresh water after sucking it out, which will result in a block with heavy white core, and in the other in a block with a large hole in it. You will note, therefore, that it requires a well organized tank crew to properly handle a raw-water freezing system. Another important feature is that when running intermittently it is necessary to keep the air agitation on the cans at all times, or at least until all the cans in the tank have been sucked out and refilled.

Water Supply.

The question of water supply for making raw-water ice is a very vital one. and should be looked into minutely. In every instance there should be analysis made of the water by a competent chemist, in order to determine whether the water is fit for the purpose, and where the water is bad, a softening plant should undoubtedly be installed. I have known of some instances where fairly good results have been obtained in an experimental way with even bad water without the use of a softener, but I firmly believe that in most of these instances a softener would be necessary to insure the commercial success of the proposition, and render it capable of being operated in a commercial manner. When you stop to consider that the water in the cans in freezing liberates its impurities, and that these are being picked up by the remaining unfrozen water, which is, hence, getting continually worse and worse in quality, you will realize the importance of this feature of the question. In a can proposition it is even worse than in a plate plant, for in the later there is left a very considerable quantity of unfrozen water after the plates are ready to harvest, while in the can system all of the water is frozen up.

Practicability to Plants Generally.

The question of the practicability of this system depends entirely whether you are willing to give the increased attention to the operation of the plant in return for the added economy. Off hand, I should say that it would pay all who have uneconomical or only moderately economical plants to install this equipment, especially if you are paying high prices for coal. Exactly what it

*Abstract of paper read at the 22nd annual convention of the Southern Ice Exchange, Tampa, Fla., February, 1912.

will do for you can only be determined after a close inspection, examination and study of your equipment. The general lines along which increased economy might be looked for, would be the installation of compound cylinders on your present engine, running it condensing, probably with barometric condenser, and keeping the auxiliaries non-condensing, running their exhaust into your present distilling system, converting your present distilled water store tank into raw water storage tank, and installing a smaller one for the distilled water. The air blowing system with air blowers and sucking out pumps would be attached to your present tanks. The investment is not so great, and considering the returns, an excellent one.

Power Plant Improvement.

In this connection I wish to say that wonderful improvement in economy can be effected by getting after the boiler, auxiliaries and leaky steam lines, etc. Study the water situation carefully, and avoid wasteful and unnecessary pumping of water. Pay particular attention to the boiler setting and devise a furnace that will give you maximum evaporation for the quality of fuel consumed. For plants of 25 tons and larger, it is recommendable to install a generating set, and drive all auxiliaries, with the possible exception of the boiler feed pumps, electrically. This will result in a decided gain in steam consumption, and will also give your engineers a little more time for maintenance of other parts, as electrical auxiliaries are decidedly more easy of maintenance than steam auxiliaries.

Pipe covering, both for ammonia suction and steam piping, is also a possible source of saving in energy, as is also insulation for the ice tank, cold storage and ice, but particularly the tanks. It is surprising the difference in ice production that can be obtained from a well insulated tank over what the same tank will do when poorly insulated. These points, however, have been so frequently and ably discussed by others that I am sure you realize their importance as well as I do.

New Raw Water Ice System.

Returning again to the subject of this paper, I wish to say that a new method of making raw-water ice is soon to be tried out in Atlanta, our company having sold the inventor a 10-ton plant for experimental purposes. This system comprises a series of cells, containing one row of cans each, through which cells, brine is circulated by means of a pump, from a brine tank and cooler located below the level of the bottom of the cells. Each ice can has a ball and socket joint on the bottom, through which a connection is established with a water header running lengthwise under the cells, each can having its own inlet. Running across the top of the tanks is another header, with a drop pipe into each can. These drop pipes are only submerged a little, about ½-inch.

In this system, the water is agitated by constant pumping instead of by an air current. The air is sucked out of the cans through the upper connections, and discharged back into the lower headers, being passed through a filter on the way. As soon as the ice closes up across the bottom, admission of fresh water is, of course, automatically stopped, and after the water pump has lowered the water level in the can to a point where the pump will no longer lift the water, about ½-inch, the water in that particular can remains idle, and freezes out unagitated. After all the cans in one cell are frozen up, the brine is drained off, the water headers quickly disconnected, and the ice cans pulled and dumped as usual.

The empty cans are put back in the cell, and filled with raw water, the brine being only admitted to the cell after all the cans are filled, the weight of the cans and the water being sufficient to make a tight joint in the ball and socket on the bottom. You will perhaps notice that this is a development of the double-can system, and exactly what can be done with such an outfit, I will be in a position to say to you next year. The adoption of this method, and its embodiment into a standard plant, such as we usually refer to, will be a matter for future consideration. It will, however, be much more expensive than the air blowing system.

Anhydrous Ammonia *

By Thos. Andresen.**

ACCORDING to history, ammonia compounds were known in ancient times. Ammonium chloride was a commercial article in Greece and Egypt centuries before Christ. About the 12th century it became known among European chemists as sal-ammoniacum. During the latter part of the 18th century, Priestly, the discoverer of oxygen, produced ammonia by collecting the gas over mercury when decomposing sal-ammoniac with lime, and called it alkaline air. Ten years later, Berthollet succeeded in decomposing this alkaline air, by means of the electric spark, into its elements nitrogen and hydrogen, developing the formula NH_3.

*Abstract of an address delivered before the Illinois, No. 28, N.A.S.E., at Chicago, November, 1911.

**Inspector of Cooling Plants, Chicago.

Sources of Production.

Natural production of ammonia results from the decay, under the action of certain bacteria, of all nitrogenous animal and vegetable matter. It is also found as a mineral deposit in volcanic districts. Many other sources from which ammonia gas could be obtained might be mentioned; but for commercial purposes, where large quantities are required, it is chiefly derived from coal as a by-product in the manufacture of illuminating gas. Coal contains a certain amount of nitrogen, and part of this gas, in the process of dry distillation, combines with the hydrogen present and forms the compound NH_3. Numerous tests prove that one-fifth of the nitrogen in coal is recovered as ammonia gas—principally during the later period of distillation. The amount of NH_3 to be obtained from good quality gas coal varies from 0.16 to 0.25 part of nitrogen to 100 parts of coal, or one ton of coal will produce about 5 pounds of ammonia gas as a product.

In the process of dry distillation, the coal gas, after leaving the retort, is cleaned and purified by running through water. This separates the gas from the coal tar and forms coal gas liquor—the substance from which ammonia is immediately derived. Much apparatus is in use for liberating ammonia from coal gas liquor. They, however, differ but little in principle, therefore, it will be sufficient to describe the important general features only of the process.

Ammonia Extraction Process.

The gas liquor is placed in a column still, consisting of a series of trays with cast iron hoods. Flowing over the serrated edges of these trays, it parts with its free ammonia and descends to the lower level of the still, where it meets a quantity of milk of lime—separately prepared and pumped into the still and agitated and heated by direct steam to a temperature of 195 degrees Fah. By this process the fixed ammonia is liberated while the sulphuretted hydrogen, H_2S and carbonic acid, CO_2 present are retained by the lime. The free vapor, leaving the still at the top is partially cooled by a reflux condenser and purified by charcoal filtration. Also, it is often led through a fatty oil-bath to retain any traces of coal tar. A strong solution of caustic soda is used to remove the last traces of CO_2 and H_2S together with any organic matter.

The ammonia is fed to a compressor and liquefied under pressure; the liquid being collected in a separate receiving tank, partly submerged in heated water, and allowed to evaporate. The final impurities are retained in liquid form at

the bottom of this apparatus. The pure anhydrous ammonia gas is again liquefied in a separate condenser and becomes the finished article—ready to fill the drums for the market. If the ammonia gas, before liquefying, is absorbed by water, aqua ammonia will be the product. Ammonia under ordinary conditions, is a transparent poisonous gas having a very pungent and peculiar odor, and if mixed with the atmosphere, 0.05 per cent. is sufficient to irritate the mucous membrane of the human body. It will not support combustion, and in a pure state will not burn. I know of a case in Chicago where an air test was forced so rapidly that a disastrous explosion took place under the comparatively low pressure of 150 pounds.

Ammonia as a Refrigeration Medium.

Ammonia under a gauge pressure of 15.6 lbs. has a latent heat of 555.5 B.t.u.; the corresponding boiling point is zero and one cubic foot of gas weighs 0.1104 lbs. Under a pressure of 33.25 lbs., the latent heat is 543 B.t.u., the boiling point 20 degrees Fah., and one cubic foot of gas weighs 0.1711 lbs. In operating a plant, therefore, the engineer should compare these values with the conditions prevailing at the different temperatures required in the coolers. In other words, the pressure corresponding to the temperature maintained in the refrigerator should be in conformity with the above, as it is the weight of the ammonia gas handled that points to efficiency.

It is often remarked that, in a compression system the gas will decompose in time, and so interfere with the efficiency. This is not true, yet, it has a characteristic which may reduce efficiency considerably, and one often neglected or ignored by engineers. It is this:—Water will absorb ammonia gas with great avidity—developing heat and great expansion.

In operating an ice machine more or less moisture will enter the system by way of the stuffing-box of the compressor, and in time will interfere with the proper working of the expansion coils. Evaporation will be retarded by the sluggish condition of the liquid; and even if the charge be freshened with new ammonia, the effect will be only temporary. To keep the ammonia in the proper state, or anhydrous condition, the whole charge should at times be redistilled. This can be done by means of a purifier without interrupting the general working of the plant.

To illustrate the benefit of a purifier, I will state an experience I had a few years ago. The output of an artificial ice plant was reduced to 10 tons per day, and the engineer was considerably worried, as he was charged up for each ton of ice delivered on the loading platform. He called on me for advice. I looked over the plant and advised the installation of a purifier. This was done immediately, and after treatment of the charge for about ten days, the lost ice tonnage re-appeared.

Quality of Ammonia.

The only test of quality that an engineer can make, is to evaporate a sample taken from a drum. If the ammonia liquid in the test tube shows a temperature of 28.5 degrees below zero. and no sediment is left after evaporation, the quality is about all that can be acquired.

It may be that foreign gases are held in solution, or are mixed mechanically with the liquid and do not show up in an evaporation test. To determine this, we may apply the following method:—All ammonia drums are about two-thirds

The late Richard Ramsay Mitchell.

filled in the factory, the remaining third being left for expansion, and being, of course, occupied by ammonia gas. In testing for foreign gases, place the drum in such position that the drawpipe inside is above the liquid level. Connect the stop valve to a piece of hose reaching beneath the surface of distilled water in a bucket, and draw off some of the gas. The gas will be absorbed by the water, and if pure will make a crackling sound. After closing the stop-valve leave everything in the same position and repeat the performance the next day. Pay attention from the start to see if there are any bubbles. These would indicate the presence of foreign gases. If such exist they will accumulate in the upper part of the condenser. and can be expelled through the purging valve.

In my opinion, the refrigerating effect on the low pressure side is not disturbed or weakened by foreign gases; but the condenser pressure will go above normal, because these gases will not liquefy once they become liberated, and so become a factor to reduce the capacity of the condenser. We can rely upon it as a fact that the liquid anhydrous ammonia placed on the market to-day is from 98 to 99 per cent. pure. Whatever impurities may be found by an exact and complete analysis, consist of traces of sulphate, lime, alcohol, benzine, and other substances in such minute quantities as to have no influence upon the economy of an ice machine.

Liquid anhydrous ammonia is placed on the market in steel drums holding from 50 to 150 pounds. These drums are tested to resist a high pressure, and in Germany are under government control, in so far that each drum is recorded and is subject to a pressure test every three years. Ammonia liquid was first converted into the solid state by Faraday. In the process, he maintained a temperature of 103 degrees Fah. below zero and applied a pressure of 20 atmospheres. Under these conditions a transparent white crystal is formed. The critical temperature of ammonia gas lies in the neighborhood of 260 degrees Fah.

THE LATE RICHARD R. MITCHELL.

Readers of The Power House will learn with regret that Mr. Richard Ramsay Mitchell, president of the Robert Mitchell Co., Ltd., Montreal, died on February 8, at his residence there. The deceased gentleman was born at Montreal in 1864 and received his education at the High School of that city. On leaving school he served an apprenticeship in the various shop and office departments of the Robt. Mitchell Co., and subsequently became a member of the firm. In the year 1896, the business was incorporated, and on the death of his father in the following year, Mr. Mitchell became president.

As a governor of the Montreal General and Western Hospitals and Board of Trade, Mr. Mitchell was well known and highly respected, while among those more directly interested in the foundry business, his vice-presidency of the American Brass Founders' Association indicated his personal worth and recognized executive ability. To those who were fortunate enough to know Mr. Mitchell in a social or business capacity, the news of his death comes with a double shock, for his generous disposition and hospitable manner will always be remembered.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Trahsmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. V. MARCH, 1912 No. 3

OUR ANNUAL REFRIGERATION NUMBER.

RAPID growth and development in the field of refrigertion and cold storage warrants attention being drawn to the subject in a special manner. The perfection of equipment towards securing commercial success is daily widening the scope and application of this important accessory to our creature comforts and necessities; as a consequence, therefore, the subject in its various phases should be, at least, broadly understood and appreciated. In the present issue, opportunity is given for the acquirement of an intelligent and comprehesive idea of the leading principles involved and adaptations practised.

GRADED CERTIFICATES FOR ENGINEER OPERATORS.

EARLY in the present month two deputations of operative engineers waited on the Hon. J. S. Duff, Minister of Agriculture, Province of Ontario, for the purpose of stating their respective views on the subject of graded certificates, with the ultimate aim of amending or otherwise the existing Act relating to their profession. We say, amending or otherwise, because while the aim and intent of the first deputation was entirely in the direction of legislation towards a triple classification, that of the other declared for a continuance of the present apparently equal and uniform rating.

Let us say at once that we hold no brief for either section, nor do we make it our business to make our views coincide with or contribute to the propagation of the ritual of any body of men banded together, by whatever name known. The Power House is neither the official nor unofficial organ of the "pro or anti graded certificate" divisions of the engineer operators in Ontario or other provinces of the Dominion of Canada, and its expressions of opinion, given from time to time on questions affecting the welfare and uplift of the profession will be unbiassed and reasonably set forth, as we see them, for the consideration of each individual number of the craft.

Having, as we hope, made our position clear, for the present as well as the future, and in view of the fact that the subject of graded certificates is live and prominent, meantime. we, naturally, may not sit on the fence.

Men in all trades and professions, at least those who serve, and most of us partake of this honor, are possessed of certificates of competency, independent altogether of any parchment or title bestowed by a university, board of examiners, employer, or other such society or individual. The latter are, as a rule, the outcome of some special application to the pursuit of knowledge which will be not only in the manner of a series of amendments to an inborn or natural constitution, but a means taken advantage of, whereby the person so equipped may best, successfully and honorably sustain his individual manhood. Independently, however, of the opportunity to educate themselves or secure parchment or titles, we find men possessed of nature's certificates of competency, and nobody would make bold to say that there is in this aspect of the subject, even a semblance of equality of rating. Further, it is just as true that all of us individuals have not and cannot have the like chances, or opportunities, if you like. It, therefore, seems contrary to all the principles governing human intelligence and existence that there should be other than a desire to provide a step ladder which will not only have distinguishing levels, but will, in a brief space, require removal to a surer footing on a higher plane.

Graded certificates may not, we are aware, secure for the various holders their heart's desires, but they certainly will provide a most powerful incentive to individual efficiency and ability in the performance of the duties of the operating engineer. Further, the delay in their becoming an accomplished fact, is bound to be short-lived. In every great and successful movement, there have been conspicuous what we might term the one, two, three and lesser lights. These leaders or progressives realized in every case the surety of failure by attempting to compass their ideal en masse, and wisely set about instilling into the individual components, the preparatory instruction to help themselves.

The operating engineer may not trifle too long in these progressive times as to what he wants and what he does not want. Manufacturers and power plant owners were never more alert and active in sifting out and investigating both plant and personal records, and while the operator is unaware of the cause, he may find that his apparently low remuneration is a closely figured return determined from the standpoint of personal capacity. We cannot blame a manufacturer or power plant owner for evening-up and recouping losses, due to inattention, want of intelligence or incapacity, by paying small wages, and while this may or may not be the real reason, the opportunity, which graded certificates will afford of showing an employer your accomplishments in having attained a higher rating of proficiency, and of enabling you to exercise a higher degree of intelligent operation, supervision and executive ability, is well worth the earnest endeavor of all who have not only their own best interests at heart, but the best interests of their individual associations as well.

The Refrigerating Plant at the Winnipeg Abattoir

By T. H. W. C.

Being a brief illustrated description of a modern abattoir refrigeration equipment whose design and layout has furnished highly satisfactory results, not only in the present instance, but in the numerous other cases where the system has been applied.

OF the many recent installations of refrigerating machinery in Canada, one of the largest and most interesting is that of Messrs. Gordon, Ironside & Fares at their Winnipeg abattoir. The building, situated on Logan Ave., is undoubtedly the most modern of its kind in the country. The amount of space controlled by artificial cold amounts to over 400,000 cubic feet, and in addition to this the plant is of sufficient capacity to chill about 300 head of cattle and hogs per 24 hours.

Machinery Equipment.

Fig. 1 shows the power house in which are two 100 ton Linde horizontal double acting ammonia compressors supplied and installed by The Linde-Canadian Refrigeration Co., Ltd., Montreal. The compressors are of such construction as to be easy of access for attention and overhaul. The various wearing parts are large and the valves are so designed and arranged as to keep tight without the use of oil, and if necessary may be easily removed. The stuffing boxes are of such construction that no ammonia can escape if the machines are properly attended to. The efficiency of a compressor depends largely on the clearance allowed between the piston and the cylinder heads. In both of these compressors, the latter are constructed spherical so as to allow the valves to be placed close against the inner sides. The piston ends are also made spherical to allow of their coming close to the cylinder heads and valves. The clearance is thus reduced to possible minimum.

The compressors are driven by electric power, being connected by belt to two 150 h.p. motors. Fig. 2 of the interior of the power house clearly shows the compressors, motors, belts, connections, etc.

Condenser.

The ammonia condenser is of the atmospheric type and is placed in the wooden building directly above the power house, Fig. 1. The condenser is made up of 14 sections of 2 inch pipe, each section being 24 pipes high by about 20 feet long. Each section is independently connected to the main header by a separate inlet and outlet valve so that any one can be shut off without affecting the remainder. Over the top of each section is placed a water trough, which allows the cooling water to run down over the coil. The hot ammonia gas upon entering the coils comes in contact with the cold surface, gets cooled down and liquefied, and collects at the bottom of the coil. Each pipe of the condenser has both ends flanged and is connected to the other pipes by flanged return bends. The great advantage of this construction is that if one pipe is found defective, it can be quickly removed and replaced without the necessity of removing a whole section.

Refrigeration System.

The cooling of the various storage rooms and freezers is accomplished by direct expansion piping; about 20,000 feet of 2-in. pipe being installed in this

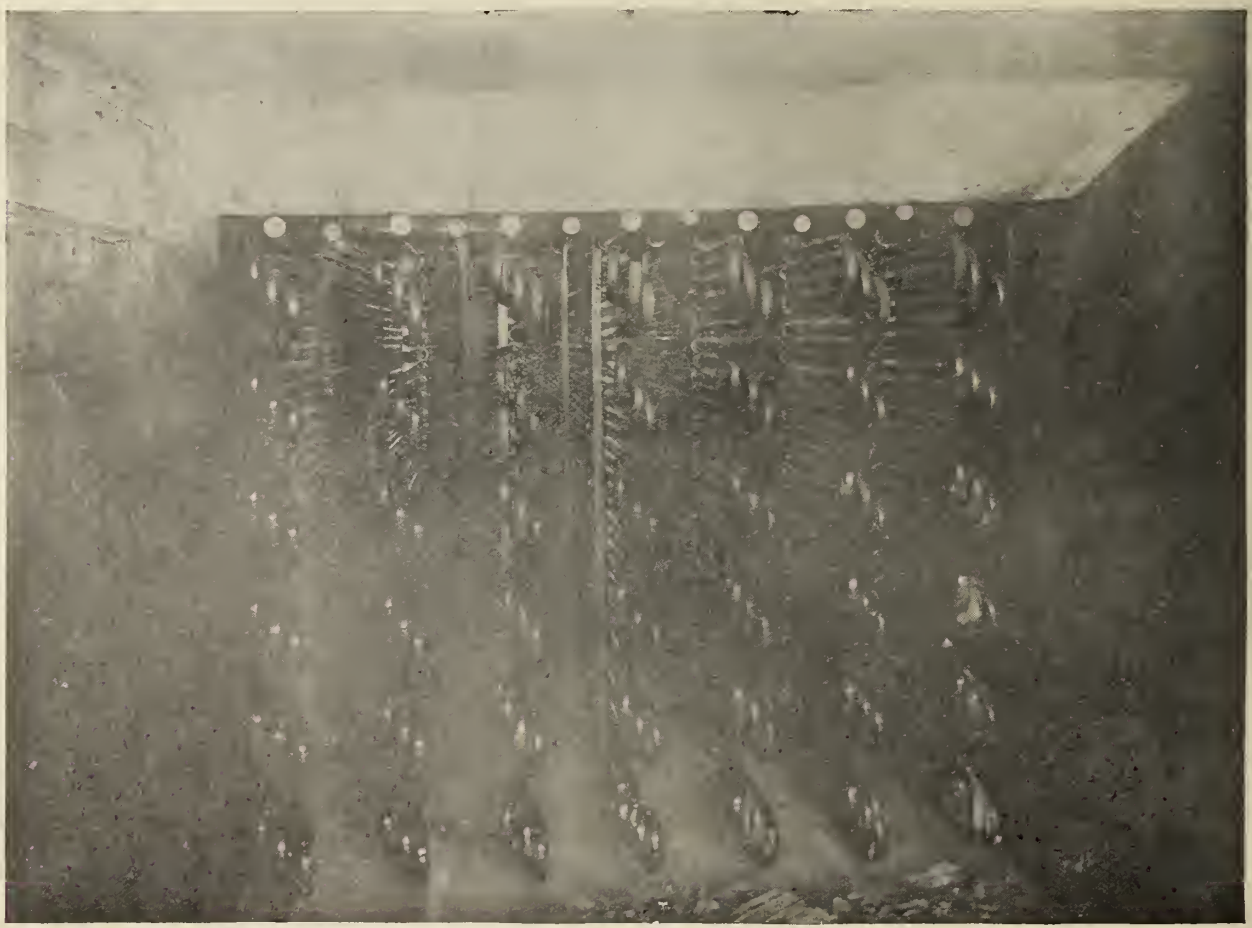


Fig. 3.—Interior Construction of Air Coolers With Brine Pouring Over the Pipes and Through the Air.

building. Each room is on a separate system, so that any one can be shut off without interfering with the others. The beef and hog chilling is done by the "Linde" patent pure air circulation system, the air being first cooled by a 60-ton air cooler, as shown in Fig. 3. The air cooler consists of a shallow rectangular tank over which the 1¼-in. extra heavy endless refrigerator coils are placed. A pump to circulate the brine over the coils and through the air, and a fan to draw the air out of the rooms and force it through the cooler, back to the rooms, form other features of the chilling equipment. All these parts are substantial in construction and as the refrigerator coils are placed in a vertical position, and at a sufficient distance apart to allow a man to get in between, they can be easily inspected, scraped and painted, a circumstance which necessarily prolongs their life considerably. As the air cooler is placed in a separate insulated space, all this can be done without in any way interfering with the rooms generally.

Fig. 4 shows a room cooled by pure air and the wooden ducts through which the air is circulated can be seen on either side near the ceiling. The principal advantages gained by this purified air circulation system are as follows: Simplicity in construction; an entire absence of snow or drip in the rooms; quicker chilling or freezing; perfect ventilation and pure air; the goods are kept in much finer condition; greater cooling efficiency, and great saving in space; all of which features are of great importance and desirable in any plant.

In addition to the large plant described here, Messrs. Gordon, Ironside & Fares have mechanical refrigeration plants in their establishments at Moose Jaw, Sask.; Saskatoon, Sask.; Regina, Sask.; Fort William, Ont.; Port Arthur, Ont., and Sault Ste. Marie, Ont. The machinery in each case was supplied and installed by the Linde-Canadian Refrigeration Co., Limited, 37 St. Peter Street, Montreal.

Fig. 1.—Power House, Winnipeg Abattoir. The Wooden Structure on Top Encloses the Condenser.

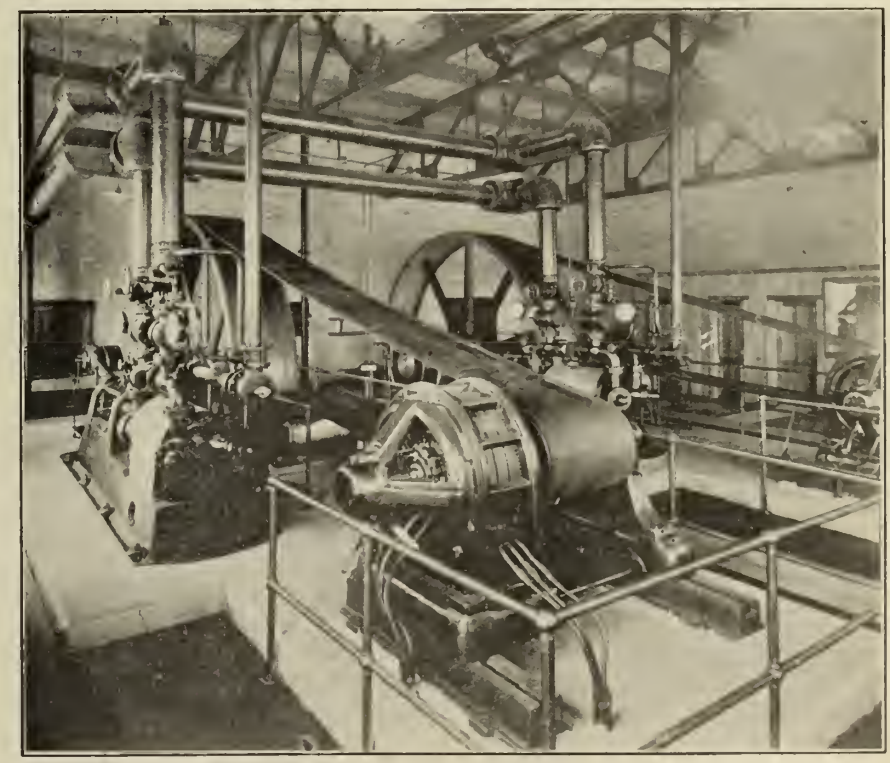


Fig. 2.—Engine Room, Showing Belt Driven Compressors, Winnipeg Abattoir.

ANNUAL BANQUET No. 31, C.A.S.E., STRATFORD.

STRATFORD Lodge No. 31, Canadian Association of Stationary Engineers held its third annual banquet at the Mansion House, on the evening of March 6, the event being distinguished by more than ordinarily excellent addresses. About 75 members and guests sat down to a delicious repast, creditable alike to the hosts and to the lodge. In the company were many ladies, principally wives of members.

Mr. Robert Patterson, master mechanic G.T.R. shops, Stratford, and honorary president of Lodge 31, made an efficient chairman. Seated on his right were:—Messrs. Wm. Preston, James Torrance, M.P.P., Ald. D. M. Wright, F. G. Scrimgeour, J. H. Gordon, president Board of Trade; and on his left, Mayor Brown, Messrs. H. B. Morphy, M.P., W. S. Dingman, W. C. McGhie, chief examiner the Ontario Government, and S. A. Cosford, of London. Sturm's orchester discoursed some excellent music while the banquet was in progress, and Miss Lennon was an acceptable accompanist to the various soloists later in the proceedings.

The speeches were of more than usual

interest, and a few of them may be reviewed:

Mr. J. A. Robertson voiced the desire of the C.A.S.E., in pursuance of its policy of education and self-improvement, for graded certificates for engineers. It would be an incentive to higher effort, and they would not rest satisfied until the qualifications of engineers could be gauged by their class certificate.

Mr. Preston expressed appreciation of the work of the C.A.S.E. in Stratford. The members were living up to their professions, and the men were better for belonging to such an association, and employers were getting better service. The manufacturers of Stratford were unanimously in sympathy with the association.

Mr. Torrance remarked that this was his third banquet during the week. He expressed sympathy with the stationary engineers' request for a system of graded certificates, and hoped they would press for it. The ambition to rise higher in efficiency was laudable. Touching on the future of Stratford, he was glad to say that Secretary Moore, of the C. N. R., had been consulting him on charters for construction of radials about Stratford and for various extensions from time to time. He was satisfied the C. N. R. plans large things for Stratford. The Ontario Government was also considering the establishment of a number of industrial schools, and he thought Stratford should be able to secure one of these if proper representation were made.

Mr. Morphy referred to the time when it was the fashion to speak of Canada as an agricultural country, and never destined to be anything else. This was changing, and he believed the time would come, through our water powers and other vast resources, when manufactures would surpass the products of agriculture. There was need of vigor in the east. Men from the west were recognizable from their mouths—they were so used to saying "millions." They have a snap and vim and executive action that the east is beginning to lack. Winnipeg already boasts seventy kinds of manufactures, Ontario must look sharp and act aggressively. A great problem for our statesmen and Governments was the regulation and assimilation of immigration. There is an economical, social and racial struggle before us, which we must face. Much depends upon the leadership of Ontario. He was in sympathy with the desire of stationary engineers for a higher status to be opened up to them. The stationary engineer was at the base of all the industries, and should be highly recognized, well paid and encouraged to increase his skill and knowledge. He would be glad to be of use legislatively at any time.

Mr. McGhie, by way of encouragement to the engineers to persist in their agitation for graded certificates, said that of the four years that certificates had been in existence, during the first two of these qualification had been confined to engineers in charge of plants of 50 h.p. or over. In the first two years there had been twelve boiler explosions and over twelve lives lost, while in the last two years, when certificates were made general, there had not been one explosion or one life lost. The door should be open to improved legislation after such a showing.

The chairman and Mr. Kastella expressed appreciation of the presence of the two riding representatives in view of the trouble which attendance meant when both Commons and Legislature were sitting.

The committee of arrangements for the banquet were:—Messrs. A. Kastella (chairman), J. A. Robertson, A. R. Benson, Alex. Scrimgeour, W. G. Walter and Geo. Hird. The officers of No. 31 are as follows:—Honorary President, R. Patterson; Past President, Alex. Scrimgeour; President, A. Kastella; Secretary, J. A. Robertson; Recording-Secretary, J. Swanson; Treasurer, G. Hird; Conductor, T. Griffin; Door-keeper. J. F. Smith.

Fig. 4.—Room Cooled by Cold Air and Showing Construction of Ducts.

The Absorption and Compression Systems of Refrigeration

By W. G. Walters.

A careful study of this article will be found instructive and educative, contributing as it does to a greater intimacy with two well known systems of practical refrigeration and, thereby, enabling engineers generally to familiarize and equip themselves for emergency or opportunity, as may be, when either presents itself.

Absorption System.

THERE are a few noteworthy features of the absorption system that call for special reference. A particularly important part is the distilling apparatus or the still, which consists of a number of different elements. Sometimes the still is reckoned as including a generator, analyzer, rectifier, and heater. The heater is also known as a heat exchanger, economizer, and as an equalizer. We will consider them individually.

The Generator.

The generator or retort in the absorption system is the apparatus in which the anhydrous ammonia is generated. The process consists in driving the anhydrous ammonia or ammonia vapor from the aqua ammonia by heat. The essential feature, then, is to have a location for the aqua ammonia so arranged that it can be subjected to heat. Suitable outlets should also be provided for the ammonia vapor when generated, and for drawing off the weak solution that remains. In practice, it has been found best to supply the heat necessary to generate the vapor by means of steam coils placed in the chamber with the aqua ammonia. The operation of the generator may be improved by having a number of these chambers placed one above the other, the strongest solution being fed into the highest, and passed on down through to the lower chambers. During the process, and while in transit from one chamber to the other, the liquor gradually becomes weaker, and by the time it has reached the lower chamber, it is weak enough to be drawn off into the weak liquid tank.

The Analyser.

This apparatus generally consists of a series of baffle plates located in a stand pipe on top of the generator. The top serves as the outlet for the ammonia vapor, and inlet for the strong aqua ammonia, the vapor being delivered from the extreme top and the aqua admitted to the uppermost suspension pan. The aqua, as it trickles downward over the series of pans and the vapor in its winding passage upwards become considerably intermingled, with the result that the vapor is largely freed from water in suspension, and becomes nearly anhydrous.

The Rectifier.

This is a small coil partly surrounded by water. As the gas cools, the small quantity of liquor that may be condensed from the gas goes to the ammonia pump. The gas inlet is at the top and the outlet at the bottom, the water taking the other direction. The efficiency of the machine depends very largely on the proper working of the rectifier. If it is not kept at the proper temperature, there will be trouble. If allowed to run too hot, the moisture held in suspension by the gas will not

W. G. WALTERS,
Refrigeration Engineer.

be removed, and will pass into the condenser and liquify with the gas. If run too cold, both the moisture and the gas will be condensed, and returned to the generator, leaving no gas to go to the condenser to supply the cooler. If allowed to become too cold, it may also cause a boil-over. A good plan is to have a thermometer attached to the rectifier, and about 110 degrees Fahr. will be found to be a satisfactory temperature at which to operate.

The Equalizer.

One of the strong features of the absorption system is the equalizer. It is designed to effect a transfer of heat between the weak liquor from the generator and the strong liquor on its way to the generator. The two liquors are passed through separate coils in close proximity to one another, or may have one enclosed within the other on the double pipe principle. The weak liquor as it leaves the generator contains an excess of heat which is advantageous to dispose of before it reaches the absorber. In the absorber, the temperature is kept low, while in the generator the contrary is the case; therefore, a transfer of heat en route is a distinct gain.

The most distinctive feature of the absorption system lies in the fact that the ammonia pump is the only mechanically operating part of the whole plant, aside from a feed pump for the boiler. The pump, however, is not an ordinary type, as it has special features to avoid loss of ammonia under the high pressures to which it is subjected. Still, the pump is only a small affair, and is generally designed to run at moderate speeds.

In this system, there is attached an automatic regulator, which operates to maintain the supply of weak liquor so as to correspond with the rate at which the pump carries away the strong aqua ammonia.

The Absorber.

In the absorber, the process takes

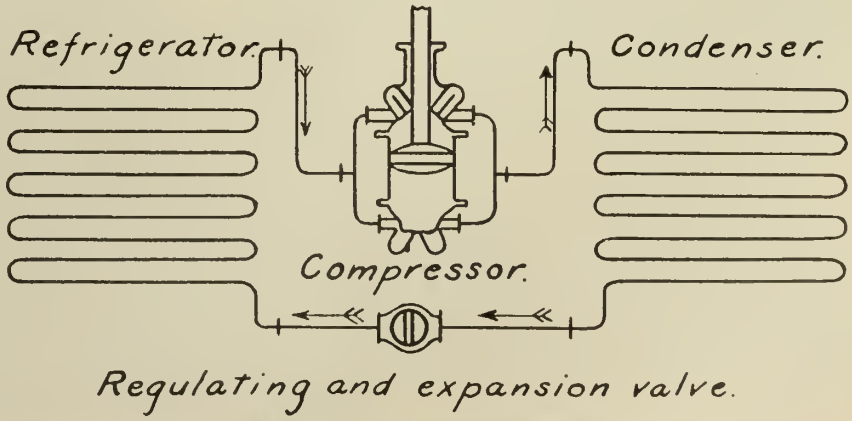


Fig. 2.—Absorption and Compression.

place which gives the name to the system. This apparatus consists of a cylindrical shell or vessel, into which the vapor of ammonia as it comes from the refrigerating coils is led, and where it mixes with the weak liquor from the lower part of the generator. It may be of the shell and coil, straight tube, double pipe or atmospheric type. The duty of the absorber is just the opposite to that of the generator, for as the process of separation in the latter is brought about by heat, so in the absorber the process is assisted by the removal of heat. To assist in this removal of heat, the absorber is supplied with cooling coils through which cold water is passed.

The absorption ammonia system in its operation involves four distinct stages or processes: (1) The generation of vapor; (2) the condensation of the vapor; (3) the evaporation or expansion of the condensed vapor from a liquid in-

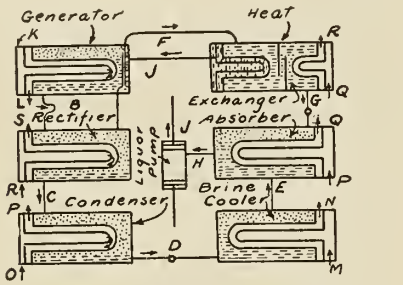


Fig. 1—Absorption and compression.

to a gas; and, lastly, the absorption of the gas. In practical operation, other features are introduced to improve efficiency and economy.

Fig. 1 is a diagram of the absorption system, which, if followed closely, will give an idea at least of the different changes and stages which are necessary in order to complete a cycle of operations.

The Compression System.

Among the systems of artificial production of ice and mechanical refrigeration in extensive use to-day, the ammonia compression system undoubtedly occupies a pre-eminent position. The medium or refrigerant used is anhydrous ammonia. The process consists of a complete cycle involving three successive changes. These are known respectively as compression, condensation, and expansion, all three stages being necessary to produce refrigeration. The ammonia is kept confined and used repeatedly, the supply being replenished occasionally as necessity demands.

At the commence of the cycle, the ammonia is in the form of a vapor. A compressor, forming the most important part of the apparatus, is in essence simply a specially-designed pump which draws in the ammonia vapor from a back pressure of from 15 to 30 lbs. per square inch, and compresses it to 150 or 175 lbs. The vapor in the beginning contains a certain amount of heat, and after compression it contains this same heat, with the addition of the heat representing the equivalent of the work done by compression. The ammonia, however, still maintains the form of a gas, notwithstanding the high pressure to which it has been subjected. In this condition, then, it is forced on to the condenser, where this excess heat is removed.

The condenser, in brief, consists of an arrangement of pipes through which the ammonia passes, the pipes being so arranged that cold water is distributed over them. In this manner the excess heat of compression is removed, and the ammonia gas is changed to a liquid. From the condenser this ammonia liquid passes to the refrigerator, where it is controlled by a valve known as the expansion valve. When this valve is opened, it allows the liquid ammonia to pass from the high pressure side of the system to that of the low pressure side.

Let us go back for a moment to the initial stage. We started off with the compressor drawing in the gas at a pressure of from 15 to 30 lbs. per square inch. Now, when the expansion valve is opened, the liquid ammonia passes from the condensing side of the apparatus, with its high pressure of from 150 to 175 lbs., Fig. 2; to the refrigerator with its low pressure, where the process of refrigeration takes place. This liquid in order to expand into a gas must have heat, and as we have abstracted the heat from it by condensation, the supply must be drawn from some other source. If we have our refrigerator in the form of pipes suspended in the room which it is desired to cool, the heat is attracted to the ammonia pipes, and the sensation of cold is produced. Again, if we wish to use what is known as the indirect system, we put our refrigerator in a tank which contains brine a mixture composed of calcium chloride and water or common salt and water. We can either circulate the brine through the rooms that we wish to cool, or we can use a system of combination brine tanks, centrifugal pumps and air fans. In the case of the air system, air ducts to and from the rooms are necessary.

Fig. 3—Illustrating Horizonal Compressor.

Compression System Diagram.

Fig. 2 is a diagram of the compression system, which will be readily understood. This illustrates the elementary arrangement of a refrigerating plant; the course of the cooling agent being indicted by arrows.

As such features as are common to both the absorption system and the ammonia compression system have been dealt with, we will now consider the motive power necessary in both. Although a small amount of motive power is required in the ammonia absorption systems to operate the pump for delivering the strong aqua-ammonia to the generator, it need not be considered in relation to the compression system, in which mechanical power is necessary to bring the ammonia to a high pressure and temperature, so that the condenser water may perform its function of carrying off the heat. The motive power, therefore, constitutes the most important feature of the compression plant. The choice of power, however, does not involve the compressor, as any kind of motive power will answer; the choice depending altogether on local conditions. The large majority of plants are operated by steam. All kinds of engines are used and all kinds of results are obtained in a strictly refrigerating plant, a first-class engine having the same advantages as in a general manufacturing plant. In the case of a can ice plant, this does not hold true, because exhaust steam is used for the production of ice, and is not quite equal to the demand; the deficiency being made up from live steam. Fig. 3 is a photo of a horizontal, 4-valve Linde compressor direct connected to a Wheelock automatic engine, the crank of compressor being at right angles with the engine crank. The capacity of this compressor is 60 tons per 24 hours, which forms a valuable unit in the refrigerating plant of the Whyte Packing Co., Stratford, Ont.

The Big River Lumber Co. Plant, Big River, Saskatchewan

By Allen Norgrove.

This plant, although located away back in the woods, as it were, is of the most modern type for its purpose, being laid out for convenience and flexibility, with reserve equipment to avoid stoppage or extended delay and inconvenience through accident or breakdown. A careful perusal of the various features will be found edifying to operators and manufacturers alike, showing as it does the wisdom of a proper initial installation for a given duty.

THE power-house, a brick building 80 x 152 feet, lies north of the sawmill and is covered with galvanized corrugated iron roofing. It is divided by a brick wall running lengthwise, forming on the east side the engine room and on the west side the boiler room.

The Boiler Room.

This contains twelve horizontal tubular boilers 18 feet by 72 inches, built by the Muskegon Boiler Works, Muskegon, Mich. There is space left for two more boilers, should it be necessary to install them. The boilers are hung in the usual way to strong steel "I" beams resting on steel posts, which, in turn, rest on a concrete foundation. They are set in pairs in Ashley steel casings, which give a neat appearance, none of the brick-work being visible. One stack connects each pair of boilers, its dimensions being 4 ft. diam. x 100 ft. high above the breaching.

Each boiler is connected through a 6-in. pipe long radius bend to a 30-inch header, from which one 12-inch line leads to No. 1 engine, one 10-inch line to No. 2 engine, one 5-inch line to No. 3 engine, two 8-inch lines into sawmill, one 4-inch line to boiler feed pumps, one 6-inch line to fire pump, a 4-inch line to the big whistle, and a few smaller lines for sawdust conveyer engine, flue blowers, etc. The boilers are also equipped with "Dutch oven" furnaces, having 8 x 6-ft. grates for burning sawdust, shavings, etc. The latter are brought in from the mill by a steel chain conveyor, which runs through fire-room, and what is not consumed in the furnaces is carried over to the fuel house, at the north end of the power-house, by the same conveyor.

When the sawmill is shut down, or not supplying enough fuel, return is made from the fuel-house by a second

Big River Lumber Co.—Refuse Burner

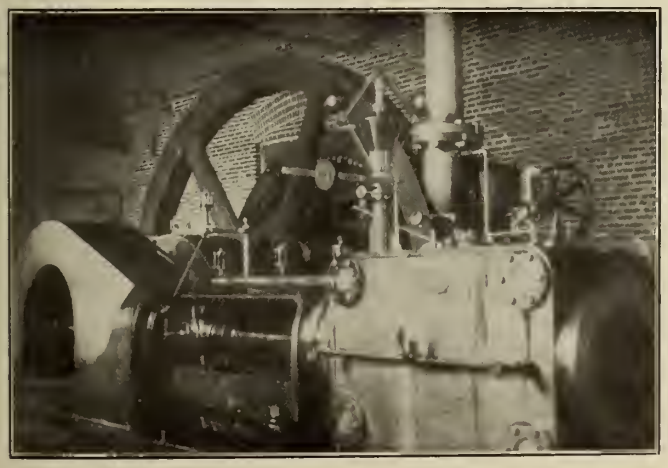
steel conveyor, driven through a "Jewel" high-speed automatic engine placed on the steel floor of boiler-room, which is level with the oven tops and engine-room floor. Under this steel floor a track is laid for wood supply and taking out ashes, etc. Each boiler has two blow-off valves, a Crane blow-off valve next to boiler, and an asbestos-packed cock outside of this, both being inside fire-room. Each boiler has a separate blow-off pipe leading to the river bank, about 70 feet away.

Engine Room.

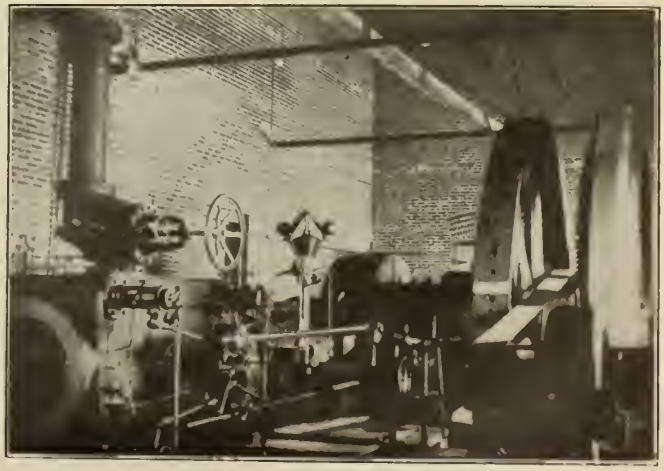
The engine room contains three simple Corliss engines of the double eccentric, long range cut-off type, built by Filer & Stowell, Milwaukee, Wis. No. 1 is a 38 x 60 inches cylinder, running 61 rev. per minute, with flywheel 24 feet diameter, 68-inch face. This engine drives the sawmill with a 66-inch leather belt 145 feet long, supplied by the Beardmore Belting Co., Toronto. In case engine should get on centre, it is fitted with barring-over cylinders. These consist of a cylinder placed on each side, near the rim of the wheel. On the cross-head end of the piston-rod is a grip which holds the rim, and lifts it the length of the stroke of the cylinder—about two feet. When reversed, it lets go, sliding down the rim until piston reaches the bottom cylinder again, ready to repeat the same operation. The cylinders are fitted with piston valves for ease of operating, and cushion is obtained by valve and port construction, as in loading and turning cylinders in sawmills. By having one cylinder on each side of wheel, it matters not to which side the belt runs, as one cylinder is large enough alone.

No. 2 Engine.

No. 2 engine has a 30 x 48 inches cylinder, and runs 100 rev. per minute. It is direct connected to a Crocker-Wheeler alternator of 1,000 k.v.a., 600 volts, 3-phase, 60 cycle. This engine furnishes power for planing mill, machine shop, etc.



Big River Lumber Co.—16-in. x 30-in. Engine.



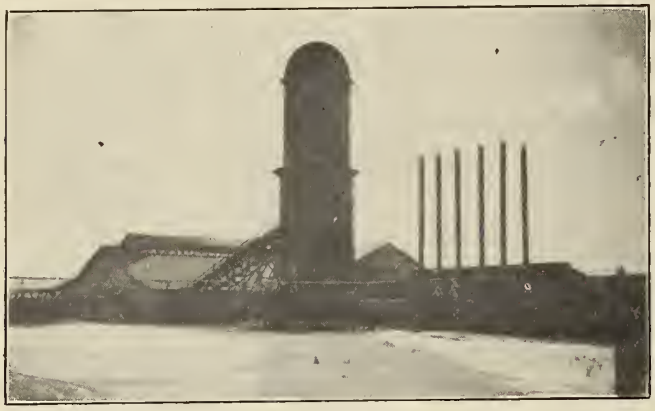
Big River Lumber Co.—30-in. x 48-in. Engine.

No. 3 Engine.

No. 3 engine has a 16 x 30 inches cylinder, and runs 120 rev. per minute. It is direct-connected to another Crocker-Wheeler, 3-phase, 600-volt, 60-cycle generator of 150 k.v.a. This engine carries the lights and a few small motors; in fact, it takes care of the load up to its capacity, at which point it is taken over by the 30 x 48 inch cylinder engine.

For town lighting, current at 600 volts is carried by a line running at right angles to the streets; a transformer placed on each street supplying a 110-volt circuit, on to which the house circuits are tapped. This system works very well, as none of the streets are long, and no difficulty is found in keeping the circuits balanced.

The other engine room equipment consists of a 2,500-h.-p. "Wainwright" derwriter pump, situated on river at water's edge for fire protection. Its 8-inch discharge comes through basement, and is connected so that it can feed direct to boilers in case all three boiler feed pumps should by any means become disabled. The boiler feed pumps are arranged to discharge into the fire line, each of them having a separate suction to the river. They can feed the boilers either through the heater r



Big River Lumber Co.—Saw Mill From Town Site.

Big River Lumber Co.—Saw Mill Looking from River.

Switchboard.

The switchboard is of finest blue Vermont marble, and consists of eight panels: one for measuring instruments for each machine, and which consist of ampere-meter for each phase, voltmeter, ampere and voltmeters for exciters. The exciter switches, and rheostats are also on the same panels. One panel carries the main switch and relay for each machine, and the other four are for distributing circuits. The switchboard stands out about four feet from wall, thereby allowing current, potential, transformers, oil switches and all fuses to be placed behind it. Current at 110 volts is used for lighting, and that used in power house and sawmill is transformed inside of power house by three single-phase transformers in engine room.

closed feed water-heater, a large oil filter, and the heating coils required to keep the room at the temperature at which the oil will flow. The oil flows by gravity from filter to engines, then to a tank in basement, from which it is pumped to the filter again, thus keeping down the oil bill.

Basement.

The basement contains the feed-water pumps, and all the valves for controlling the heating, water and drainage for the whole plant.

This is a necessity in such a severe climate (60 degrees below zero), as the frost goes down in the ground more than eight feet. The boiler feed pumps consist of three Filer & Stowell duplex pumps of the Worthington type, 10 x 6 x 10, with 5-inch suction, 4-inch discharge. There is also a Fairbanks un-

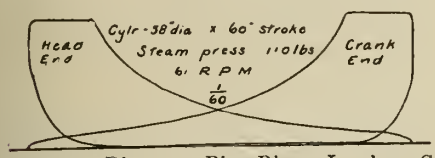
direct, and any one of them can be turned into any line independently. There is a tee on the suction pipe near pumps, where hot water from the huge refuse burner can be turned in with a head of 75 feet.

The suctions to the boiler feed pumps and discharge from fire pump come up through a concrete tunnel into the basement. Live steam to fire pump, the exhaust from boiler feed pumps, drains from header, water columns, and heating systems pass out again through this same tunnel, thereby keeping the water pipes from freezing, and maintaining open water for fire pump intake. This is only 10 feet from the pump, and makes an easy lift. All pumps are fitted with Mason regulators. The branches from the water line are all taken off the main in basement, the largest one sup-

Bird's Eye View of the Town of Big River.

Big River Lumber Co., Rafts of Logs in Front of the Mill.

plying the sawmill service. This is an 8-inch line from which branches lead out to 24 hose-gate valves located in and around the mill. There are two 50-foot lengths of hose and a nozzle in rack close by each. Another 8-inch line leads up town, with hydrants and hose to protect planing mill, and a feed line to refuse burner. All lines are carefully laid out so that any one of them can be shut off and drained in the basement. This layout cost a large sum to install, as it required many valves to

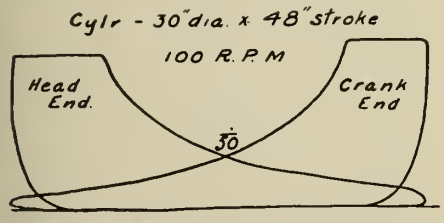


Indicator Diagram—Big River Lumber Co. engine.

secure the necessary service and control.

Exhaust Piping.

The exhaust piping is laid out with the like precautions to save a shutdown, a tee being used under each engine cylinder, one side of which is piped outside with a back pressure valve, the other side being piped to the feed-water heater line, with a gate valve for each engine. This line is of 14 inches spiral riveted galvanized pipe, and can either be made to pass through feed-water heater or by-passed through sawmill to hot pond. This pipe also collects all drains from the steam feed cylinders, as well as from some of the smaller cylinders in sawmill. The log deck cylinders, which consist of 6 cylinders for log turners, 3 cylinders for loaders, and 3 cylinders for log kickers, have a separate 5-inch exhaust line, also leading to the pond. As steam sett-works are used on the carriages, steam guides and



Indicator Diagram—Big River Lumber Co. engine—Back pressure valve open.

straining devices on the band-mills, and steam cylinders for raising skids and bumpers (in all 42 steam cylinders in sawmill), there is quite a quantity of exhaust and drains to be taken care of.

A 6-inch line off main exhaust before it enters heater leads to heating coils in saw mill, from whence a 3-inch line leads to the planing mill. About 2 pounds pressure is carried during day time, and about 4 pounds during night time. This is obtained by using a 14-inch back pressure valve on the exhaust line. The planing mill is heated by placing coils between the machines at places best suited, the machines producing the necessary circulation. The sawmill has coils and a fan placed in room on north side of the building. Air is drawn in by the fan through the coils, and then forced out through light galvanized iron piping of 4-ft. diameter at fan, reducing to 6 inches at smallest outlet.

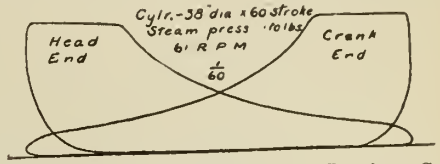
Refuse Burner.

The refuse burner stands north of the sawmill in front of power house. It is a large iron structure, 34 feet inside diameter, 140 high, with an 18-inch water space for 75 feet of its height. It has a large opening on side next mill for refuse conveyor to empty its contents, and on the opposite side a smaller one for shavings from planing mill. It stands on a concrete and firebrick foundation, and the water space is fed by four 3-inch water pipes at bottom and one 3-inch pipe up near conveyor opening. Four 4-inch pipes serve for the overflows, which are carried to hot pond by an 8-inch line. A 6-inch line is taken from near the middle of its height to suction of boiler feed pumps. This is taken up inside near the top, then through the shell and down the outside, with vent at highest point inside to prevent syphoning. A double screen is provided on top for arresting sparks, and a flare is placed at top of outer sheet of water-jacket to catch water when boiling, and return it into water space. All necessary man and hand holes are provided for cleaning out, also doors for regulating draught and cleaning bars through burner proper, besides doors for cleaning out ashes and regulating draught below bars. This outfit was by the Muskegon Boiler Works.

Sawmill.

This is a large frame building on cement footings, 273 x 125 ft., with lathmill on one side, 32 x 127 ft., and lumber sorting shed and transfer platforms, 118 x 296 ft., on the other. It contains three bandmills and carriages (with 12-inch steam feed cylinders), one vertical and one horizontal re-saw, four edgers, two sets of trimmers, all the necessary live rolls and chains for automatically moving lumber from one machine to the next, until boards are loaded on cars ready for the piling ground; also, log chains for bringing in the logs; steam cylinders for loading, turning, etc. The mill has a capacity of from 3,800 to 4,000 logs per day of 10 hours. In addition, there is a large slasher for preparing slabs for lath mill. The lath mill is capable of turning out about 90,000 per day of 10 hours.

Above the main floor of the mill is the filing room, where all the saws are sharpened, tempered, brazed, and worked up to cutting shape. This room has its own engine, so that it may be run independently. Below is the basement, which contains all shafting, belts, pulleys, friction clutches, steam cylinders, and piping, etc., for driving machinery, besides all chains and conveyors for carrying away sawdust and refuse. In the basement, also, are work benches, tool rooms, racks for oil cans, and the belt room. In this latter place, belts are made up and repaired, it being



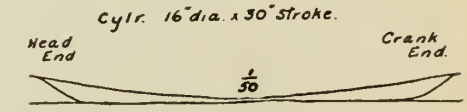
Indicator Diagram—Big River Lumber Co. engine.

equipped with a full line of tools for cutting, scraping, glueing, riveting, etc.

Planing Mill.

This is a frame building, 209 x 100 ft., situated about 350 feet away from sawmill, with C. N. R. tracks running alongside. It contains 10 planers, 1 moulder, 1 edger, 2 trim-saws, 1 table saw, and 2 re-saws. Overhead is the filing room, where all the saws are kept in cutting trim, and at one end is the grinding room, where all the knives are sharpened and shaped.

It is equipped with Sheldon's (Galt) patent blower system for gathering up shavings and delivering same to fuel house. By this system, shavings and sawdust are collected by two 75 h.p. motor fans, having pipes to each machine and other parts of the building where shavings fall. Delivery is into a large separator, the air passing out through the top, while the shavings fall to the bottom and pass into a machine with revolving cylinders open at each end. These, in turn, come under the separator, and fill with shavings, then



Indicator Diagram—Friction load—Big River Lumber Co. engine.

under the pressure pipe of a large rotary blower. At the same time the other end of cylinder is directly over discharge pipe leading to fuel house. This pipe is 13 inches diameter, and is fitted with a valve and branch pipe to refuse burner, when shavings are not needed for fuel. The power equipment in planing mill, including back heads for planers, filing, grinding rooms, and blower system, consists of 28 Crocker-Wheeler motors, ranging all the way from 75 h.p. to 10 h.p.

Machine Shop.

The machine shop is a large building situated about 300 feet from sawmill. It contains one large planer, 36 inches x 16 feet; one large and one small lathe, shaper, nut and bolt machine, power hack-saw, drill presses, tyre bender, pipe cutting and threading machine, etc. There is a blacksmith's shop adjoining. The machine shop is driven by a 50 h.p. motor, and the blacksmith's shop is equipped with a small motor-fan for blowing fires.

Round-house.

There is a round-house for steam log haulers, containing a locomotive-type boiler, a Marsh pump, and the usual equipment for washing out and repairs. A blacksmith shop is also attached.

Manufacturers of Equipment.

All the sawmill machinery was supplied by Filer & Stowell Co., Milwaukee, Wis. Boilers and burner by the Muskegon Boiler Works Co., Muskegon, Mich.; piping and valves by the Canadian Fairbanks Co. and the General Supply Co., both of Winnipeg; belting by the Beardmore Belting Co., Toronto, through the General Supply Co., Winnipeg. Planing mill machinery was all supplied by the Berlin Machine Works Co., Berlin, Ont., together with Sheldon's patent blower system. All the electrical equipment was supplied by the Canadian Crocker-Wheeler Co., St. Catharines, Ont.

Big River Township.

The town is situated east of plant, on high ground, the streets running north and south. It is well governed, clean and sanitary, with comfortable dwellings. There is a large boarding house, butcher's shop, post-office, railway station, schoolhouse, hospital, two churches, main office, a large retail store, and a big wholesale warehouse, with spur into same from main track. This latter institution is a necessity, as there are 25 lumber camps to be served besides the town. The population numbers between 800 and 900, while large numbers are continually going to and from the camps.

The town, with its stores, offices, churches, schoolhouse, etc., as also the sawmill, planing mill, and all machinery therein, the boarding house, lumber yards, tracks, etc., were carefully planned, laid out and erected under the supervision of Mr. W. A. Graham, the present superintendent. There are two mail and passenger trains per week, in addition to freight and supply trains. The company owns a gasoline car, which plies between Big River and Prince Albert.

CELEBRATION OF FIFTIETH ANNIVERSARY.

In honor of the fiftieth anniversary of its founding, The Lunkenheimer Company, of Cincinnati, Ohio, tendered their employees and families an elaborate entertainment and dance, Saturday evening, February 17th. Over 4,000 people attended. The event was given at the O.N.G. Armory, which is the largest hall for events of this kind in Cincinnati. Provision was made for the entertainment of the employees' children and they were present in large numbers. Refreshments to meet the taste of men, women and children were served in great abundance.

Some conception of the marvelous growth of the Lunkenheimer Company in less than a life-time may be had when consideration is given to the fact that in 1862, when the late Frederick Lunkenheimer laid the foundation of the company, it was but a small one-man shop. By the production of only the highest grade of engineering specialties, he created a demand for his products that soon necessitated larger work shops and more men, and this increase in space and employees has continued until to-day The Lunkenheimer Company occupies large and magnificent factories, covering acres of ground and in which are employed 1,500 men. The products of the company have an international reputation, and are extensively used all over the world.

Not only is The Lunkenheimer Company among tthe largest manufacturers of high-grade engineering specialties in the world, but it produces the greatest variety of these articles, chief among them being brass, iron, semi and cast steel valves; water columns and gauges; ground key work, whistles, injectors and ejectors; lubricators, oiling devices, oil and grease cups, automobile and motor boat specialties.

STUART & FOSTER LTD.

STUART & FOSTER, LTD., agents for the Canadian Ammonia Co., Ltd., formerly the Michigan Ammonia Works, have purchased the property at the corner of King and Berkeley Streets, in order to have their offices and warehouse in closer proximity to the ammonia plant on Front and Parliament Streets. They will occupy the present four-storey building. The firm now own and operate the business of John G. Harvey, Ltd., which, since 1882, has been in the ammonia field in Toronto.

They are introducing a specialty known as "Non-Rust Black Paint," for pipes, coils, etc. It is claimed to be odorless and, therefore, suitable for application in rooms where sensitive and delicate food products are stored. Another attractive feature is the fact that it does not dry hard, hence the chipping of ice from the pipes is accomplished with the minimum of labor and time spent. Its qualities have been subjected to prolonged service in some of the largest plants, and commendatory letters bear out its sufficiency.

DRYDEN TIMBER & POWER COMPANY.

Contracts were recently awarded Chapman & Walker, engineers, Toronto, for the supply of the electrical and hydraulic equipment covering the plant of the Dryden Timber & Power Co., Dryden, Ont. The following form some of the principal items: Two 1,000 h.p. waterwheels and two 750 k.v.a. generators, 600 v., 60-cycle, 360 r.p.m. Motors aggregating 2000 h.p., and ranging in size from 10 to 150 h.p. One motor-driven turbine boiler feed pump, running 300 r.p.m. One 2,000,000-gallon turbine pump for main water pumping at 105 ft. head. Eight "Conquerer" cyanide type pumps for handling caustic soda and stock.

The pumps are being supplied by W. H. Allen, Sons & Co., Ltd., Queens Engineering Works, Bedford, England, and will be direct connected motor-driven.

140,000 VOLT TRANSFORMERS.

Twelve single-phase, 60-cycle, 3,000-kilowatt transformers are being built for delta connection on the 140,000-volt transmision system of the Eastern Michigan Power Company. These transformers will occupy a floor space of 11 by 5 feet, and will reach to a height of 19 feet from the floor to the top of the high-tension terminals. Each transformer will contain 4,000 gallons of oil. Three of the twelve transformers are designed for a secondary voltage of 2,470 volts in one circuit. Three transformers are designed for simultaneous service on four secondary circuits of 370 volts, with 125 kilowatt capacity each; one secondary circuit of 5,560 volts with 1,000 kilowatt capacity, and one secondary circuit of 44,000 volts with 1,500 kilowatt capacity. Three transformers are designed for one secondary circuit of 370 volts with 125 kilowatt capacity, one secondary circuit of 5,560 volts with 2,250 kilowatt capacity, and one secondary circuit of 2,200 volts with 500 kilowatt capacity. The three remaining transformers are designed for two secondary circuits of 370 volts and 125 kilowatt capacity each, and one secondary circuit of 22,000 volts and 2,750 kilowatt capacity. Oil-filled leads are used, having an over-all dimension of 7 feet 4 inches, and containing 30 gallons of oil each. The transformers are designed to withstand a test of 280,000 volts from the high-tension winding to all other parts.

De La Vergne Standard Horizontal Compressor

By C.T.R.

This article features the constructional details of a machine which has found large favor in Canadian installations, and gives readers an opportunity of adding to their knowledge of and intimacy with the types and product of different manufacturers.

THE latest De La Vergne compressor is horizontal and double acting. The predominant features of its design are accessibility. Every piece of machinery, no matter how well built, is subject to the possibility of minor derangements; casualties, which, while they do not interfere with the continued operation of the plant, require prompt and careful attention. If the various parts are not accessible they cannot be examined and repaired without great difficulty and loss of time. While, therefore, it is essential that a machine be strong and durable, it is equally important that the various parts be easy of access.

General Features.

Though substantially alike in all essentials, the details of the compressor vary somewhat in the various sizes. Fig. 1 shows a twin cylinder compressor driven by a tandem compound Corliss Engine, while Fig. 2 illustrates sectional views of the compressor cylinder and its various appurtenances. The compressor cylinner, constructed of close grain cast iron, is provided with water jackets through which is circulated the cooling water necessary to prevent excessive rise in temperature. The piston is of the one-piece type and has provision for 3 rings. The piston rod enters the cylinder through a metallic packed stripping box and gland. The packing space, of considerable depth, contains an oil chamber by means of which the rod is lubricated: a feature claimed for the arrangement being the fact that a minimum of oil is carried into the cylinder.

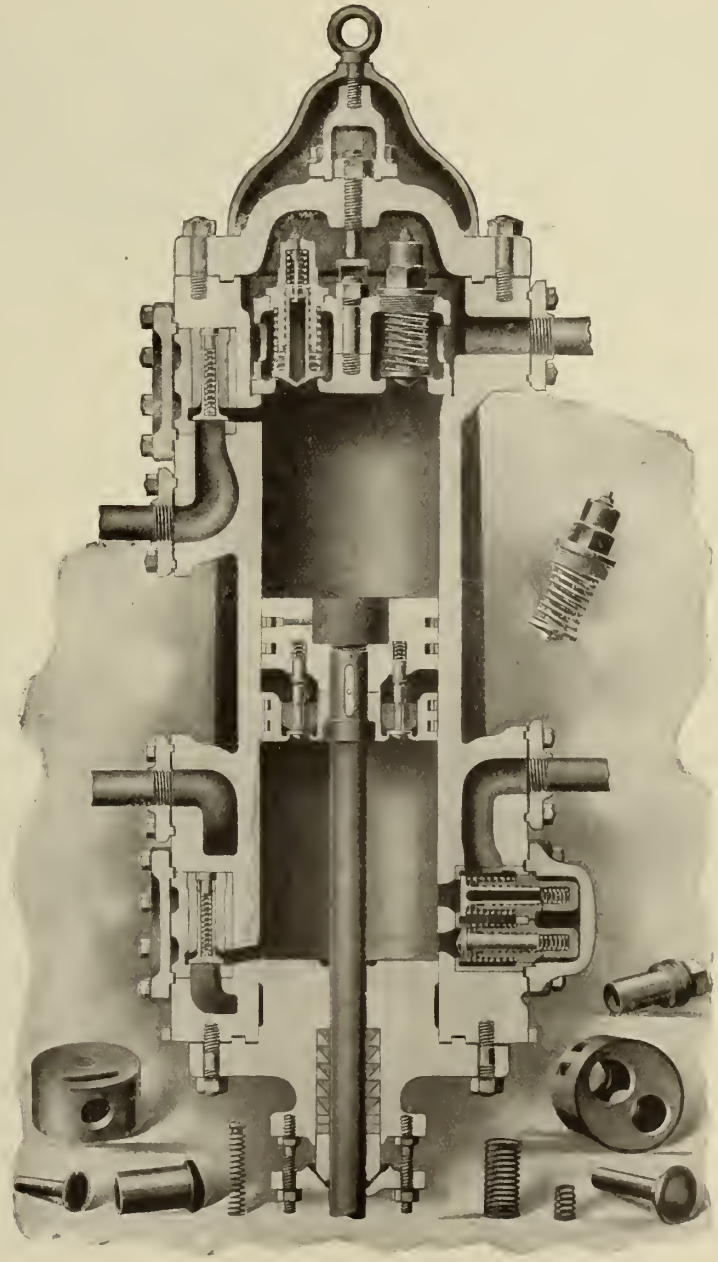
The valves face each other on opposite sides, at a level somewhat lower than the cylinder bottom, by which arrangement it is impossible for any part of the valve mechanism to become detached and enter the cylinder. Both the suction and discharge valves are contained in a cylindrical barrel or guide which fits snugly into the main cylinder casting. The inner end of the guide is shaped to engage with a removable seat which in its turn is dove-tailed into the metal of the cylinder.

The joints between the valve seat, the guide and the main cylinder casting are adjusted so that when pressed together into position, the whole will be absolutely gas-tight.

Concentrically located within the guide and cast in the same piece with it, is the sleeve which carries the valve, and into the extreme end of the valve is screwed the valve-stem. This is provided with lock-nuts for holding the piston, which moves back and forth in the dash-pot, and so prevents chattering. In the case of the discharge valve, the dash-pot consists of a pocket or recess in the dash-pot cover, which fits over the piston as shown. In the case of the suction valve the recess is contained in the guide casting. Both valves are provided with springs of sufficient strength to keep them closed under balanced pressures.

By removing the bonnet the guide may be withdrawn, and with it the valve, valve seat, etc. Each detail of the mechanism is, therefore, rendered easily and quickly accessible by the removable of 8 bolts, and without disturbing other compressor connections. The cylinder head may also be removed without interfering with the valves or pipe connections.

These are important considerations, as every disturbance of pipe connections means not only loss of time, but almost certain trouble in the future with leaky joints. It should always be the aim, never to interfere with ammonia piping, if at all possible, after its erection.



Cross Section of Cylinder.—De La Vergne Vertical Ammonia Compressor.

Types of Compressor.

One of the principal points in favor of the horizontal compressor is the absence of stuffing box troubles. When the piston rod enters the cylinder at its lowest point, the stuffing box opening soon becomes a receptacle for any liquid ammonia that may find its way into the cylinder, and as the piston rises and falls, this alternately boils and condenses; producing violent changes of temperature which are communicated to the piston rod and stuffing box. On this account, the stuffing boxes can never be kept tight, and are, therefore, a continual source of trouble.

The Single Acting Machine.

In all mechanical apparatus, a certain amount of power is required for running the machine itself. This is known as the friction load; it does not, however, increase in equal ratio with the work performed. As the single-acting machine does useful work during one stroke only in each revolution, while the double acting unit performs useful work on both strokes when running at like speeds. it follows, with the friction load practically equal in each case, that the double acting machine is the more efficient. Double-acting machines have now become almost universal. The writer is indebted to the De La Vergne Machine Co., New York, for the cuts accompanying this article.

STUART, DRINKWATER & HINGSTON, LTD.

Incorporation, with a capital of $50,000 has recently been granted to Stuart, Drinkwater & Hingston, Ltd., Montreal. The firm will represent in Canada, the Brush Electrical Engineering Co., London, Eng., dealing in their complete line of electrical machinery, electric rolling stock, and electric supplies. In addition, they will represent Messrs. A. W. Penrose & Co., also of London, Eng., manufacturers of the Penrose electric elevators. They will take over the Canada Ford Co., Ltd., of which Mr. Stuart is president; Mr. Drinkwater, vice-president, and Mr. Hingston, secretary-treasurer—these three gentlemen constituting the sole shareholders of the companies.

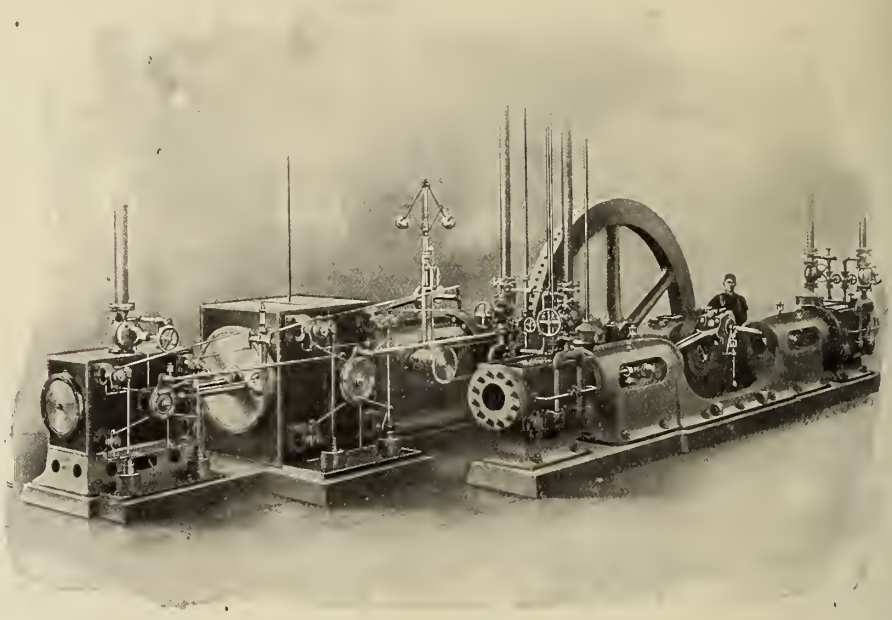


Fig. 1.—Twin Cylinder, De La Vergne Horizontal Ammonia Compressor, Driven by Tandem Compound Corliss Engine.

The Jones Cold Store Door Co., Hagerstown, Maryland, U.S.A., have just received the order for the supply of 110 refrigerator doors from the Canadian Fish & Cold Storage Co., Prince Rupert, B. C. This is believed to be the largest number and highest tonnage of refrigerating doors so far installed by American manufacturers in Canada, and bespeaks strongly the sufficiency of the product of the Jones Company.

The longer I live the more I am certain that the great difference between men, between the feeble and the powerful, the great and the insignificant, is energy—invincible determination—a purpose once fixed, and then death or victory. That quality will do anything that can be done in this world, and no talents, no circumstances, no opportunities, will make a two-legged creature a man without it.—Buxton.

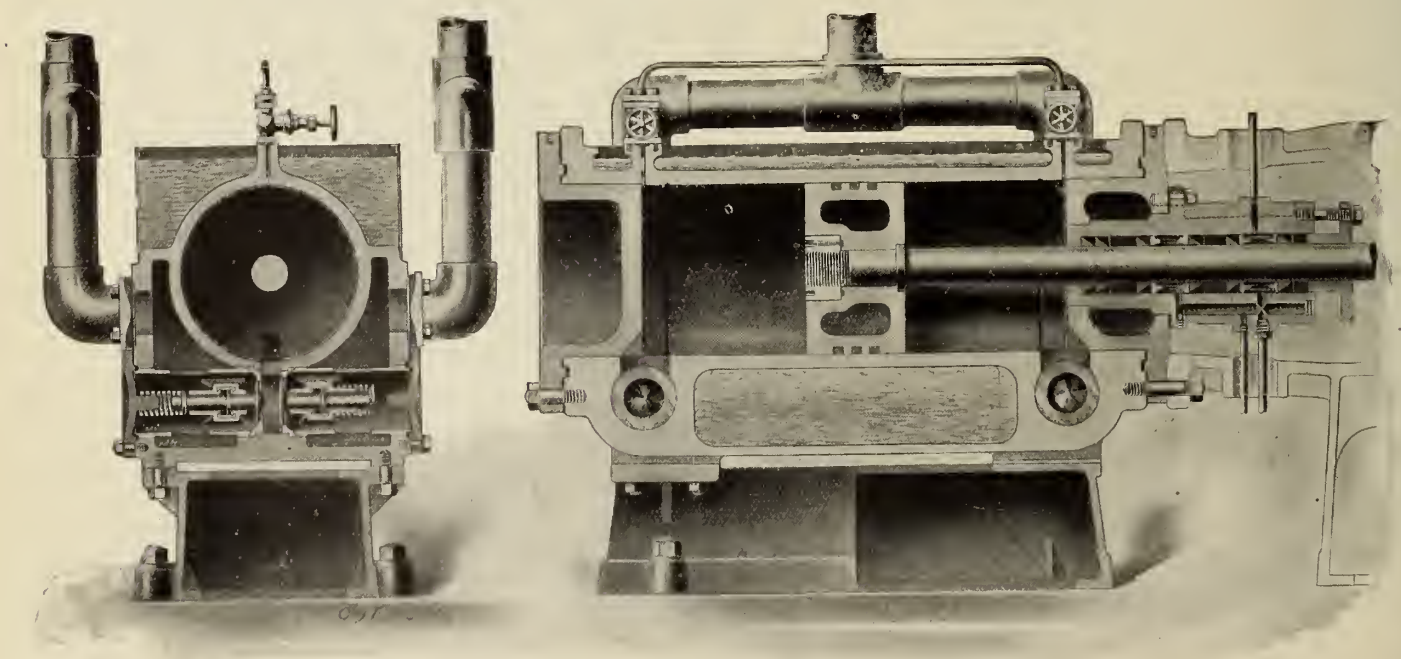


Fig. 2.—Sectional Views of De La Verne Hor izontal Ammonia Compressor Cylinder.

The Question of Prime Movers for Electric Power Plants*

By A. A. Potter**

The choice of prime movers for the power equipment of a manufacturing or public utility corporation is at times a somewhat difficult proposition to determine satisfactorily, due to the multiplicity of considerations to be accounted. The writer of this paper gathers together in compact form the leading types of prime movers and features them, so that the weeding-out process towards a final solution becomes tolerably easy and reliable.

THE function of a prime mover in an electric power plant is to convert some form of energy, as found in nature, into mechanical rotation of a shaft, which may be direct connected to an electric generator, or have its power transmitted by some form of flexible mechanical connection, such as a chain, rope, belt or gear drive. Small generators are usually belt driven from the prime mover shaft. The prime mover for a belt drive should be selected to run at such speed as will not necessitate the employment of belt tighteners. This means that the pulley ratios of the driver to the driven must not be greater than six. The essential requirements of an electrical power plant are reliability and economy, both of which are determined by the characteristics of the prime mover, and to a much smaller extent by the electrical equipment.

Types of Prime Movers.

Prime movers may be constructed to utilize the rays of the sun, which are the principle source of all energy, and a motor of this type is said to have developed during a recent test at Philadelphia, about 30 horse power; the cost of the machine being estimated at about $200 per horse power. While the solar motor may meet with some success in small sizes for tropical regions where fuel is expensive, it is impractical on account of high first cost and bulk in relation to the small power developed.

The wind motor is also limited in its field of practical application. The two commercial types of prime mover, which make the wheels go round and turn the armatures and fields of dynamo-electric machinery, are the hydraulic and thermodynamic.

Hydraulic prime movers are more expensive and lack positive reliability, as compared with thermodynamic motors. The advantages claimed for them are low operating costs, but this holds good only when the load factor is high, as with a low load factor, the operating costs are considerable. Other items worth noting in connection with hydro-electric development are the mechanical and electrical interferences which take place in long transmission lines, when the centre of distribution or market for the electrical product is far removed from the place where the electricity is manufactured.

Operating and Distribution Costs.

Recent reports from the New York Public Service Commission show that the operating cost of New York central stations using thermodynamic prime movers is only about 26½ per cent. of the total cost of production; the remaining 73½ per cent. being made up of overhead and distribution charges. This shows that the cost of manufacturing electricity is not the large item. Thus, the hydraulic power plant cannot compete in most cases with the thermodynamic power plant, as its reliability is affected by continued dry weather, floods and ice, as the case may be. The lack of positive reliability can be remedied by the installation of a reserve unit in the form of a thermodynamic motor, but this means considerable expense in first cost and stand-by losses, and may not prove profitable, unless the hydraulic development is of considerable magnitude.

Thermodynamic Prime Movers.

The thermodynamic prime movers, more popularly called heat engines, are developing in one form or another about 85 per cent. of the total power in this country and demonstrate without doubt their adaptability for all purposes requiring mechanical rotation. They are operated with gases or vapors as working media; the fuel being mainly carbon in different forms, such as wood, coal, petroleum oils and gas. The conversion of the heat energy of the fuel into work can be accomplished by external or internal combustion methods; mechanical rotation being produced directly in the case of turbine forms, and by the interposition of the sliding block linkage in the case of the reciprocating types.

The external combustion method is accomplished in the case of steam and hot air motors by burning the fuel entirely outside of the engine cylinder, and transmitting by conduction, the heat thus developed to the working substance, or the heat medium, which is water in the case of the steam engine, and air in that of the hot air motor. This working substance undergoes pressure, temperature, volume and entropy changes, converting heat into work.

In the internal combustion types of prime movers, the fuel is burned in contact with the working medium, which is usually air, inside of the motor cylinder or in a communicating vessel or space; the heat generated by this combustion being converted into mechanical work. Of the external combustion types, the hot air engine, while working very nearly on the Carnot cycle, has poor fuel economy and is very bulky for a given power. Its life is short, also, on account of the burning out of the large metal heating surfaces which transmit heat to the working substances; air being a very bad conductor of heat. This type of prime mover is used to some extent for pumping water where the cost of fuel is a secondary consideration, and where safety and simplicity are matters of prime importance.

The steam engine, either of the reciprocating or turbine type is the most perfect example of external combustion heat engine, possessing as it does a mechanism so ideal in its functional and structural detail, as to place it at the head of the list of thermodynamic prime movers, as far as reliability, low first cost and dependability are concerned. Of the two types, the reciprocating steam engine has engaged in its evolution the master minds of the engineering world for many decades, and the resulting prime mover has a diversity of form adapted to various uses. Thus, steam engines have been developed for the propelling of trains, automobiles and steamships; for farm work, pumping and hoisting; and for the driving of various classes of electrical and mechanical machinery. Each type has its distinctive characteristics, fitting it for the special work it is designed to perform.

Types of Steam Engine.

The simplest type of stationary steam engine is provided with a plain D slide valve and throttling governor. The characteristics of this engine are, fixed cut-off, which occurs late in the stroke, simplicity of construction and low first cost. The plain slide valve types are suitable

*Paper read before the Kansas Engineering Society, January 25, 1912.

**Professor of Steam, Gas and Mechanical Engineering, Kansas State Agricultural College.

for use in places where high fuel economy is not essential, the load nearly constant, and the facilities for repairs meagre.

The various automatic types of engines were developed primarily for the driving of electrical generators. These are classified, according to their rotative speed or revolutions per minute, as high and slow speed engines; the piston speed in feet per minute being usually higher in the latter class. The distinctive characteristics of the high speed automatic engine are a short cylinder, occupying little space and the employment of some form of balanced valve, the position of which is varied according to the load fluctuations by some form of inertia or fly-wheel governor.

To the slow speed automatic types belong steam engines which have a rather long stroke in comparison with the cylinder diameter. Engines of this type are usually provided with a drop-cut-off form of valve gear and have a slow speed of rotation. Corliss engines with detachment valve gears are prominent examples. Other forms of slow speed automatic engines are provided with poppet or gridiron valves. In nearly all of these, the function of the governor is to set a stop which unlatches the gear and releases the valve.

Some manufacturers are now building engines with the Corliss form of valves, but without valve gear release, the speed regulation being accomplished by some form of fly-wheel governor. These, while giving the economy of the Corliss releasing engines, have a much higher speed of rotation and are very suitable for the driving of alternators.

Steam Turbines.

The steam turbine works on the same thermodynamic cycle of operations as the reciprocating engine, but its functional and structural details are designed to utilize velocity, while those of the reciprocating engine refer to static pressure. The pressure drop required to produce the velocity of the steam jet is accomplished in fixed nozzles in the case of the impulse types, and within the moving element of the machine in the case of action and re-action steam turbines.

Impulse steam turbines are constructed on the simple-impulse and multi-impulse principle. In the first case, the pressure drop is accomplished by single expansion in one set of nozzles, and the high velocity of the jet is abstracted by one set of moving vanes. To reduce the speed of rotation to a practical number of revolutions, helical gears are interposed between the turbine and generator shaft, or the turbine wheel is made of large diameter. In the multiple impulse types, the pressure drop is carried out in several steps or stages, each stage being provided with a set of nozzles and one or several wheels for velocity abstraction.

In the action and re-action types of steam turbines, the pressure drop and acceleration takes place gradually and in small steps in each set of fixed and moving vanes. Lately, turbines of the mixed flow type have been developed, these combining impulse with re-action elements.

Internal Combustion Engines.

The internal combustion principle is embodied in two commercial types of thermodynamic prime movers, one working on the Otto cycle and the other on some modified form of the Brayton or Diesel cycle. To the first belongs the various explosion engines in which the heating phase takes place at constant volume, necessitating the employment of some ignition system for firing the charge. In the engines working on the modified Brayton or Diesel cycle, the heat medium, air, is usually compressed to a very high pressure, and the resulting temperature is sufficiently high to ignite the fuel, producing very nearly a constant pressure combustion line. The cycle of operations in the Otto explosion types can be carried out in two or four strokes, and engines have been developed which work successfully in either the two or four stroke cycle type. Of the two types, the four stroke cycle engine has a higher mechanical efficiency and a greater field of application than the other. The combustion engines of the Diesel type are best adapted for the utilization of liquid fuels, but their mechanism is more delicate and their cost much higher than that of the explosion types.

Many internal combustion engines of the hot vaporizer type are in operation and are giving good satisfaction with the various grades of cheap and heavy liquid fuels. Some attempts have also been made to develop a gas turbine, but up to the present time no commercially successful machine has been produced.

Comparisons of Relative Adaptability.

The internal combustion engine in any form has a much higher thermal efficiency than the steam engine or turbine. Also the best fuel economy of the internal combustion engine is reached in comparatively small units and is but little affected by the size of the engine. With the steam prime mover, the economy depends on the size, and the maximum fuel consumption is not attained by reciprocating engines in sizes less than 500 horse power, while the limit is still higher in the case of steam turbines.

To offset its aforementioned advantages, the internal combustion engine is more costly, its economy more influenced by the load factor, and it is not as suitable for the parallel operation of generators, as is the steam prime power. Also, an internal combustion engine when rated at its actual capacity will stand no overloads, as its maximum capacity is reached when a full charge of a mixture of the highest possible heat of combustion and density has been admitted to the cylinder. From this it is evident that the greatest field of application for the internal combustion engine is in comparatively small sizes. This type of prime mover is especially advantageous for electric power stations of 500 to 1,000 kw., where four or more units can be made to carry the load, with the consequent high load factor of each unit and the increased reliability of service. The internal combustion engine is also applicable as an auxiliary for a hydraulic power plant, or as an emergency or peak load unit in a steam-electric power plant. In large units, the internal combustion engine is not a competitor of the steam prime mover, unless the fuel cost is very great, or the power plant is located at a place where fuels especially suited for internal combustion engines can be obtained at a very low price. This is due to the fact that the steam prime mover, in large sizes, has a thermal efficiency not much inferior to that of the internal combustion engine, and offers additional advantages as far as first cost and reliability of service are concerned.

As to the relative advantages of steam prime movers, the various types of steam turbines are very uneconomical when operated non-condensing, and on account of the high speed of rotation, are not suited for the driving of large direct-current generators. The reciprocating engine should, therefore, be selected in all cases where the plant must be operated non-condensing, and in large sizes, if the engines are to drive direct-current generators. The steam turbine is meeting with considerable success in small units as a motor for the driving of exciters, pumps and other machinery requiring a high speed of rotation. For the driving of direct-connected alternating current generators, the reciprocating engines with the non-releasing type of Corliss valve gears will prove very satisfactory in sizes of 100 to 500 horse power. The high speed automatic engine is suited for units under 200 horse power, while engines with some form of drop cut-off gear or gridiron valve will be found most satisfactory in sizes above 500 horse power.

An American-Thompson Indicator Would Help You Stop Wastes

And the engineer who can stop wastes increases his earning power

Do you get that? Merely looking wise doesn't get promotion and more pay. It's the progressive man who does things with a view to betterment, who seizes opportunities and improves them, who ultimately advances to be a "top-notcher."

Many a business through lack of proper management, yet backed with ample capital, has been forced to suspend, mainly through wastes and leaks that should have been stopped.

The American-Thompson should be in the possession of every prudent Engineer whose ambition is betterment in the plant over which he has control and personal advancement as an indispensable factor in its management.

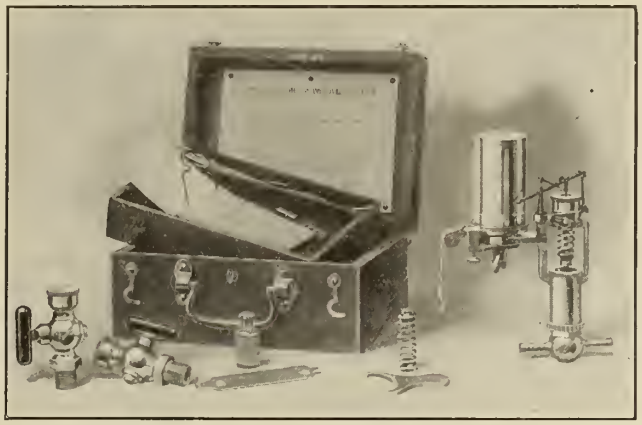
The American-Thompson is the first and foremost aid to the chief. It aids him to develop all that's good and useful, not alone in the plant, but in himself.

Prevention of Waste

In the power plant this is a matter not to be overlooked. The wastes of fuel, break downs, shut downs, loss of time and power, can all be avoided if care and watchfulness are exercised. These are matters of great importance to the concern which pays the bills, and which is quick to recognize any savings that are made.

Many a business struggling for existence could be made profitable through the use of waste matter which had never been considered of any value, and had always been thrown away.

The engineer who can prove his ability to stop waste in the power plant and turn it into profit, vastly increases his earning power and is always in a position to demand recognition.



The American-Thompson is the original Thompson Indicator. It is the most imitated instrument on the market. To be absolutely sure of getting the right indicator, ask for the "American-Thompson Indicator made by The American Steam Gauge & Valve Mfg. Co." Always specify it in that way.

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What would a master carpenter do without a spirit level? How true would be the work installed by him?

You, Mr. Engineer, should study well the import of this. And not alone that, you should know of what great importance an indicator is to you in your profession.

The American-Thompson is an Indicator of the highest quality; it originated with us, has been made solely by us and is backed by more than 35 years of continued satisfaction-giving service.

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There are a great number of points about an American-Thompson Indicator that no other Indicator has in its make-up. For instance, the 3-to-1 pencil motion that no other Indicator dares attempt to imitate.

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These and many other features, all of great importance to the Engineer who wants everlasting accuracy in an Indicator, are distinctive qualities of the American-Thompson. The way is paved for you to possess one of these more than useful Indicators, on the easiest kind of easy terms.

Your future interests demand that you take advantage of our liberal offer. Get in the band wagon to-day—our offer is a straightforward proposition.

Price of Outfit

The price of the outfit as shown is $55.00 with reducing wheel $65.00. If you want the detent motion add $15.00. The terms are easy—made easy to put this standard instrument within your immediate reach—$5.00 down, $5.00 per month.

You send $5.00 and two good references; we ship outfit at once and it's yours for examination for 5 days. Don't put this matter off any longer—take up our offer now.

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In general, the steam turbine does not offer any advantages over the reciprocating types as a power plant unit in sizes under 500 horse power, its field being mainly in large units for driving of alternating current generators. This type of prime mover in large units, while having an economy as good as the very best types of reciprocating engines, costs less per horse power, offers considerable saving in the cost of building and foundations, and produces also a saving in the feed water, in that it requires no internal lubrication; thus facilitating the return of the condensed steam to the boilers without oil filtration. The exhaust steam turbine is capable of producing considerable saving when installed in connection with a reciprocating plant. A recent installation of a 1000 k.w. exhaust steam turbine produced a saving of $14,000 in one year in a plant of 3500 k.w. capacity. Some large plants using reciprocating engines and exhaust steam turbines show a thermal efficiency of nearly 21 per cent.

From the foregoing discussion, it is evident that each type of prime mover has its field of application in the generation of electricity, and that no one of the commercial types will supplant all others for all purposes.

CORONATION DURBAR, DELHI, INDIA.

The P. & O. Steamship "Medina" in which the King and Queen went to India is equipped with seven Belliss & Morcom Steam Engines direct coupled to dynamos for electric lighting and power service. The trains on the Bombay-Baroda & Central India Railway are each fitted with a Belliss paraffin engine for lighting purpose. The special power house installed for lighting and illuminating the Durbar Camp at Delhi contained five Belliss engines direct coupled to generators. and the King and Queen's headquarters at Circuit House, Agra, were also equipped with a Bellis paraffin engine electric lighting set. Altogether, in connection with the Imperial visit, there were in use 15 engines of Belliss & Morcom manufacture. which engines, when operating at their maximum output (as they no doubt were at the time of the celebration) are capable of exerting a total of nearly 4,000 horse power.

The engineer, who had charge of the power station, reports that with full illuminations and the plant running at maximum load, the whole equipment worked without a hitch throughout. The special Coronation Durbar Medal was conferred on him in recognition of his services.

CLEAR ICE QUERY AND ANSWER.

J. C. M. Calgary, has difficulty in securing clear ice from his plant of which the following information is furnished, and asks, through the columns of The Power House, how he may remedy the trouble. The equipment consists of a 4½ ton ice machine, which takes care of one beer cooler, one meat cooler and makes in addition 800 pounds of ice. The temperature in the cooler is 32 degs. F., and in the brine tank, 15 degs. F. There are 14-six gallon cans in the brine tank, which are filled direct with water from the city mains, at a temperature of 38 degs. F. It takes about 12 hours to freeze the water content of the 14 cans, and the resulting ice is always of a milky color. Clear ice is our correspondent's requirement.

W. G. W., Stratford, in answering the foregoing query, states that it is impossible to make clear ice mechanically from any water not distilled. All water in its natural state contains air in suspension, and no successful method has been devised to remove it except by the process of distilling. While J. C. M. has not furnished overmuch data on which to discuss the matter as fully as we would like, it is just possible that part of the trouble may be eliminated as follows:—If the brine tank is of sufficient size I would recommend increasing the number of cans to 28 or more and keep the brine at a temperature of from 26 to 28 degs. F., with suction pressure of about 28 pounds. Mechanical agitators to be purchased on the market, whose purpose is to agitate the water while freezing, help to some extent to lessen the trouble of milky ice, but unless given close attention, these are liable to be frozen in the can. Of course it does not necessarily imply that because the ice is not clear, that it is not hygienic, although ice for marketing, usually, is required of the transparent quality. This latter feature, as was stated in the opening sentence is attainable only by distilling.

ELEVATOR CONTRACT.

The contract for the elevators in the new C.P.R. office building, corner of King and Yonge streets, Toronto, has been awarded to the John McDougal, Caledonian Ironworks Co., Montreal.

There will be five hydraulic direct plunger elevators with the necessary pumping and signaling equipment. Three of these elevators for passenger service will have a lift of 188 feet, and one of them a lift of 199 feet. The fifth, used for ashes, etc., will have a lesser lift. The passenger elevators will be provided with every modern device to secure speed and safety in operation, including automatic limit stops, which, independently of the operator, will slow the speed down gradually at the top or bottom without shock or vibration. They will be operated by Worthington compound steam pumps, and will be directed by an elaborate flash light signal system. In general features, these elevators will be similar to those built by the same company for the new C.P.R. Windsor Station, Montreal.

DELEGATIONS RE GRADED CERTIFICATES.

A delegation representing the Canadian Association of Stationary Engineers, and consisting of Messrs. Walters, Robertson, and Kastella, Stratford; Clark and Crockett, Hamilton; Wickens, Marr and Terry, Toronto; Begley, Port Arthur, and Heeg, Guelph, waited upon the Minister of Agriculture, the Hon. J. S. Duff, on March 6, for the purpose of advocating the amending of the present act relating to stationary engineers, by the provision of graded certificates. Messrs. Torrance and McPherson, M.P.P.'s for North Perth and West Toronto, respectively, introduced the delegation.

Another deputation, a day or two after, waited upon the Minister, with a stated case against legislation affecting graded certificates, which circumstance, taken in conjunction with the object of the previous delegation, goes to show that there exists a lesser or greater divergence of opinion on the subject.

CITY OF

Moose Jaw, Sask.

TENDERS for STEAM PLANT

Sealed tenders, marked "Tenders for Steam Plant," addressed to the City Commissioners, Moose Jaw, will be received up to 10 A.M. of Wednesday, April 17th, 1912, for contract "D" consisting of:—

Section 1. Water - tube boilers and accessories.

Section 2. Mechanical draft equipment.

Section 3. Fuel economizer.

Section 4. Coal and ash handling equipment.

Specifications and all information may be obtained on application to J. D. Peters, Electrical Superintendent, Moose Jaw.

The lowest or any tender not necessarily accepted.

A. W. MAYBERY,
L. W. RUNDLETT,
W. F. HEAL,
City Commissioners.

Moose Jaw, Sask.,
March 12th, 1912.

Cyclone with "Norivet" Head

Watch Your Coal Pile

Put a **Liberty Tube Cleaner** on guard. The "Norivet" head can be taken apart and repairs made without the use of tools. The freely swinging arms have a hammering effect that **no other type of head can produce**. This allows the cutters to reach clear to the iron and removes **all the scale**. It will also do the work in much less time and at less cost for repairs than any other tube cleaning device.

Let us send you a Liberty on trial and you can see for yourself what a **real tube cleaner** can do.

Write the nearest Branch:
MONTREAL, 320 St. James Street. TORONTO, 95-97 Front Street. WINNIPEG, 260 Princess Street.

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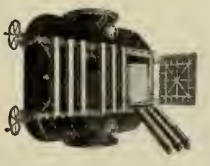

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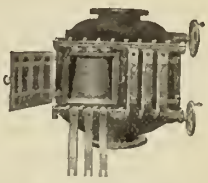

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A Complete Line of
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SINGLE STRAINER

We are manufacturers. Therefore, our interest does not cease with the sale and delivery of any apparatus you purchase from us. We are interested in the satisfactory operation after installation of every piece of apparatus leaving our shop.

We have made a thorough study of the present demands of scientifically managed plants. We know what class of equipment to supply to meet these exacting demands and spare no effort or expense to furnish the proper article.

The success of any piece of apparatus is dependent on its details. We devote particular attention to details, their design and construction. We further use the best of materials only, in the construction and have a system of thorough inspection and testing before any apparatus leaves our factory.

It will pay you to obtain detailed information regarding our Accessories. Write the nearest Branch.

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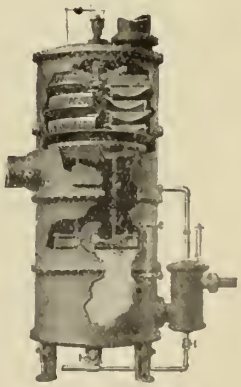

PITTSBURGH
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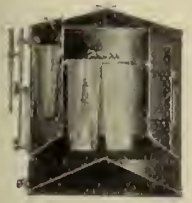
HEATER



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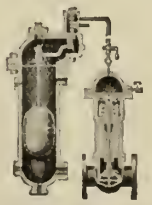

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THE VILTER MFG. CO. AMMONIA COMPRESSOR.

THE Vilter Mfg. Co., Milwaukee, Wis., make a specialty of ice-making and refrigerating machinery, many examples of their product being found installed throughout the Dominion of Canada. Their ammonia compressors, of which we give an illustration in section, are of the horizontal double-acting type, and like the designs of other reputable concerns, absence of complication, therefore satisfactory service and freedom from trouble, are prominent features.

The cylinder is a hard, close grained semi-steel casting in the form of a sleeve. It is rough bored and turned true on the outer circumference of each end, then hydraulically pressed into the cylindrical housing of the frame; fitting at the ends only and leaving an annular space to serve as a water jacket. The finishing cut through the cylinder and crosshead guides being made at one setting, secures perfect alignment. The valve chambers are cast integrally with the heads, and are bored radially to the centre of the sphere of the heads. Further, when the valves are in position, the valve seats are flush with the inner concave surface of the heads, leaving no gas pockets or clearance spaces.

The valve chambers are closed by semi-steel caps secured by cap screws, the joints being of the male and female type, compressing soft metal gaskets. The suction and discharge chambers are inter-connected by ammonia pipe or semi-steel flanged conduits and fittings. The main side outlet stop valves for suction and discharge sides are cross connected, and a simple manipulation of the by-pass valves secures a complete evacuation of either side of the ammonia system at the will of the operator.

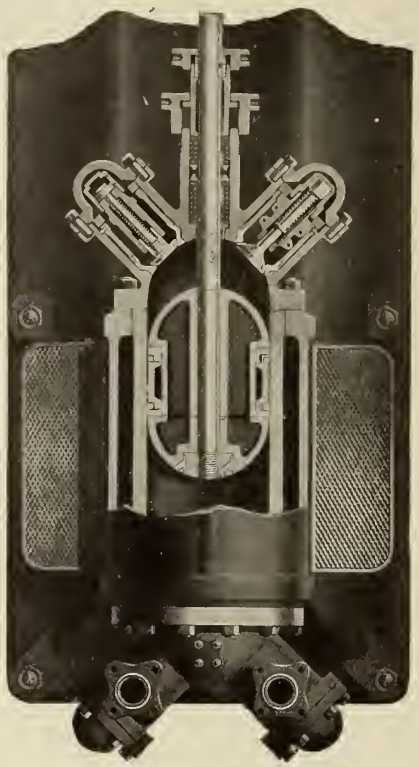
Suction and Discharge Valves.

The suction and discharge valve cages are securely housed in the valve chambers cast on the cylinder heads. They are prevented from turning by small keys registering in keyways cut in the chambers, and are held in position by large retaining nuts or collars, which are in turn secured against backing-off by steel set screws. Circular ports in the cages register with the outlets from the chambers and provide for free gas passages. The valves are accessibly located in the cylinder heads, and can be removed, inspected and replaced, with little expenditure of either time or labor, and without disturbing pipe connections.

The Compressor Piston.

The compressor piston is of a design which deviates somewhat from the ordinary form, and while its manufacturing cost is high, it is retained in the general ensemble, because of its satisfactory performance, the long service it gives, and its proven trouble-saving features. The complete assembly takes the form of an elongated sphere, the central cylindrical section being made up entirely of the bull rings and spring rings, and presenting large bearing surface to the cylinder walls. The spider and follower form the ends of the piston, and each is turned to a true half sphere to conform to the bore of the cylinder heads; all being finished to the same radius.

The chrome nickel steel piston rod and the spider are finished up after they are pressed together; the rod being turned true, highly polished, and threaded on each end. The follower nut screws on



Horizontal section Through Compressor—The Vilter Mfg. Co., Milwaukee, Wis.

the end which extends through the follower and is locked in position by a composition metal filling which is poured through a hole drilled in the follower, completely filling a wide channel turned in the nut. The composition metal can be easily removed if the piston is to be disassembled. The cross-head end of the rod is threaded in order to provide exact positioning of the piston relative to the cylinder heads, thus providing for close clearance regulation. The piston adjustment is locked at the cross-head by a heavy steel jam nut.

The Stuffing Box.

The main stuffing box is sufficiently deep to accommodate two series of packing. A collar or bushing at the inner end of the box fits tightly into the head, and is lined with babbitt around the inner surface next to the rod. This collar forms the seat for the first series of packing rings, which when placed in the box to a proper depth, are followed by a lantern which forms a bridged chamber around the rod. This lantern registers with a hole drilled near the centre of the stuffing box, from which a small pipe leads to the suction pipe of the compressor, thus relieving the second series of packing, which follows the lantern, from high pressure, should any gas find its way through the inner set of packing rings. The gland is made in the form of a long hollow sleeve, and provides an annular chamber around the rod through which oil circulates freely and keeps the rod cool while performing effective lubrication. A key-way is cut in the gland, which slides on a small key and prevents the gland from turning with the stuffing box nut; the nut being screwed on the neck of the box, in preference to bolted gland construction, to secure perfect alignment of the gland and equal pressure all around the packing when the nut is screwed up. A secondary stuffing box is provided at the forward end of the gland or sleeve to prevent the oil from working out.

The cross-head, connecting rod, crank shaft and outboard bearing are each of high grade material and construction, and in conformity with the latest and best engineering practice and the firm's experience. Liberal provision for a thorough and systematic lubrication of all moving parts is made; a hand oil pump or automatic pressure pump being furnished for the compressor, a gravity feed or automatic pressure system for the stuffing box sleeve; a wyper and cup for the crosshead pin; a centrifugal oiler of the pendulum type for the crank pin; and a complete set of high grade, glass bodied, nickel plated oil cups for oiling the crosshead guides and main bearings.

These machines are built in 19 consecutive sizes from 6 by 12 inches to 24 by 48 inches, and may be had for belt drive or direct connection to a steam engine.

John Weise, formerly superintendent of the boiler department of the Canada Foundry Company, Toronto, Can., has resigned to take a similar position with the Gem City Boiler Works, Dayton, Ohio.

Mr. A. Leo Mieville, Resident Engineer for W. H. Allen, Son & Co., Ltd., Bedford, England (who are represented in Canada by Chapman & Walker, Toronto) has recently left on an extended tour of the West, which will embrace calls at all the leading towns and cities en route.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

Vancouver.—The Canadian Brewing & Malting Co., Vancouver, B.C., are enlarging their cellarage and installing direct expansion piping, new attemporators, etc. The latter part of the work is in charge of the Modern Refrigerating Co.

Prince Rupert—The Canadian Fish & Cold Storage Co. is improving its plant by adding a 50-ton refrigerating machine with shell brine cooler, etc., furnished by the Triumph Ice Machine Co., Cincinnati, O.

ALBERTA.

Calgary—The Mountain Spring Brewing Co. who are erecting a new brewery, to be ready for operation in August next, will install a 30-ton refrigerating plant, contract for which was let to the Vilter Mfg. Co., Milwaukee, Wis.

Calgary—The Canadian Pacific Railway Co. are installing a 15-ton York refrigerating plant, in connection with their dining car storage rooms, which will be insulated with Nonpareil corkboard. The contract for machinery aud insulation was let to the Kent Co., Ltd., refrigerating engineers, Montreal, Que.

Calgary—The Mountain Spring Brewing Co., Calgary, Can., is erecting a new brewery to be of about 35,000 barrels annual capacity. It is to be equipped with a 30-ton Vilter refrigerating machine. Plant is to he ready for operation in August, 1912.

Medicine Hat—The Western Canada Cold Storage Syndicate, of Winnipeg, has arranged to purchase the assets of the defunct Western Packing Co. at Medicine Hat, Can. A new company is to be organized to operate the packing plant.

SASKATCHEWAN.

Regina—The City Cold Storage Co., who are building cold stores, are installing a 20-ton York horizontal machine: contract for this plant was let to the Kent Co., Ltd., refrigerating engineers, Montreal, Que.

Regina—Hugh Armour & Co. are installing a 25-ton York horizontal machine and plant complete, contract for which was let to the Kent Co., Ltd., refrigerating engineers, Montreal, Que., who are also installing a 1-ton York machine in Armour's retail market.

ONTARIO.

Toronto—Gunns Limited, meat packers, are installing a 125-ton horizontal refrigerating machine; also Nonpareil corkboard insulation, contract for which was let to the Kent Co., Ltd., refrigerating engineers, Montreal, Que.

Toronto—The Manning Cold Storage Co. are installing a 65-ton horizontal York refrigerating machine; also insulating building with Nonpareil corkboard insulation, contract for which was let to the Kent Co., Ltd., refrigerating engineers, Montreal, Que.

Toronto—Wm. Davies Co., Ltd., are equipping their retail store with an 11-ton York vertical refrigerating plant, contract for which has been let to the Kent Co., Ltd., refrigerating engineers, Montreal, Que.

Toronto—The Copland Brewing Co., Ltd., are insulating their cellars with Nonpareil corkboard insulation, contract for which has been let to the Kent Co., Ltd., refrigerating engineers, Montreal, Que.

Harrison—The Wm. Davies Co., Ltd., are increasing their refrigerating space by additional rooms, which will be insulated with Nonpareil corkboard, and equipped with direct expansion piping, contract for which has been let to the Kent Co., Ltd., refrigerating engineers, Montreal, Que.

Grimsby—A company is being organized by C. J. McCallum, manager of the Ontario & Western Co-operative Fruit Co., to establish and operate a fruit precooling plant, using the intermittent vacuum system. A plant large enough to precool 25 carloads daily is projected.

Ottawa—Plans have been prepared for what will be the finest artificial ice rink on the continent to he huilt here in the business section of the city, and not far from the present Dey's Arena. It will seat 10,000, and, it is understood, will he built hy a company, which is composed of the Messrs. Dey and others. They are at present non-committal about it. The intention is, if present plans go through, to have it ready for next season's games, in which Ottawa, Toronto, Montreal and Quebec hockey teams will compete.

Toronto.—Murphy Iron Works, Detroit, Mich., is now making an installation of 5 automatic furnaces at the plant of the Don Valley Brick Works, Toronto. The aggregate horse power is 842.

Simcoe.—A contract has just been closed for the installation of 3 Murphy Iron Works auto-

HAVE YOU TRIED

MONCRIEFF'S "UNIFIC"

WATER GAUGE GLASSES?

They never corrode. They last longer.

They defy competition.

For full information apply to our Canadian Representative,

W. J. WALL,

134-136 Bleury St. - Montreal

Power Equipment for Sale

2—Tandem Compound Wheelock Engines, cylinders 21" and 38" x 46" stroke.
2—Fly-wheels 18' diameter, 46" face.
2—Double leather belts, each 112' long, 42" wide.
2—Tubular water heaters.
2—Northey jet condensers, cylinders 12" and 18" x 18" stroke.
1—6" line shaft, 15' long, with friction coupling and pulley 4' 11" x 46".
6—Fire tube boilers, each 63" diameter, 14' long, containing 84 three-inch tubes. Pressure allowed by Boiler Insurance Co., 110 lbs. per sq. inch.
2—Northey feed pumps, cylinders 5" and 8" x 12" stroke.

All the above steam and water connections in very good order. These engines were started in 1894, but were seldom used, being an Auxiliary Plant. Offers will be received for all or any of this plant by

THE OTTAWA ELECTRIC COMPANY,

35 Sparks Street, OTTAWA, ONT.

Power Transmission Equipment and Machinery

MECHANICAL MATERIAL CONVEYORS, INDUSTRIAL RAILWAYS.
Includin Rails, Switches, Frogs, Cars, etc.,

——FOR——

MILLS, FACTORIES, MINES, GRAIN ELEVATORS

We carry in Stock a complete line of Transmission Equipment as below.

Iron Pulleys,	Couplings,	Boot Pans,	Buckets,
Solid and Split	Post Hangers,	Shaft Hangers,	Sprocket Chain Attachments,
Sprockets,	Post Boxes,	Friction Clutches,	Car Movers and Pullers,
Bearings,	Take-up Boxes,	Belting,	Iron Work for Dumps,
Gears—Spur, Bevel, Mitre,	Boots,	Belt Tighteners,	Spiral Conveyors.
Shafting,			

Equipment and Supplies for 50 Grain Elevators carried in stock at all times.
SEND US YOUR SPECIFICATIONS.

THE MANITOBA BRIDGE AND IRON WORKS, LIMITED
WINNIPEG, MAN.

matic furnaces at the plaut of tbe Dominion Canners, Limited, Simcoe. They will have a horse power total of 450.

QUEBEC.

Montreal.—The Canadian Ice Co., Ltd., Montreal, Can., has been organized witb $500,000 capital, by Hon. F. L. Beique, Lt.-Col. Smart, J. Robinson and others. Tbey have taken over J. A. Brooks' natural ice plant, but contemplate erecting additional ice houses in the future. An ice harvest of about 30,000 tons is being secured.

Montreal—Tbe Frontenac Breweries Co., who are building a new brewery at Mile End, to be ready for operation iu November next, have decided to build in connection a 100-ton ice-making plant.

Montreal—The Citizens Artificial Ice Co. has been organized, tbe organizers including Robt. Bickerdike, M.P., J. C. Redmond, James Robinson and others prominent in business or official circles. A 200-ton ice-making plant, it is reported, will be erected as quickly as arrangements can be concluded.

Montreal—The Board of Control in its report to the city council recommended the installation of a refrigerating plant to cost about $25,000, in Ronsecours Market.

NOVA SCOTIA.

Halifax—A project is under way to establish a large modern cold storage warebouse. J. A. Leaman & Co., pork packers, are among those interested in the enterprise.

TRADE NOTES.

The Kent Company, Montreal, who are the sole Canadian agents for the York Manufacturing Co., manufacturers of ice-making and refrigerating machinery, and of the Armstrong Cork Company, manufacturers of Nonpareil corkboard insulation, Nonpareil cork pipe covering, and Nonpareil steam pipe covering, have received orders recently and installed refrigerating plauts for the following: 125-ton equipment for Gunns Limited; 125-ton equipment for Halifax Cold Storage Co., Halifax, N.S.; 65-tou equipmeut for Manning Cold Storage Co., Toronto, Ont.; 25-ton equipment for Henry Gatehouse, Montreal; 25-ton equipment for the City Cold Storage Co., Regina, Sask.; 25-ton equipment for Hugh Armour & Co., Regina, Sask.; 15-ton equipment for C. P. R. Dining Car Dept., Calgary, Alta.; 11-ton equipment for Davies Co., Ltd., Toronto, Ont.; 8-ton equipment for National Land, Fruit & Packing Co., Mimico, Ont.; 15-ton equipment for Toronto General Hospital, Toronto; 8-ton equipmeut for Wellesley Hospital, Toronto; 2-ton equipment for Toronto University, Torouto. Also Nonpareil corkboard insulation for: The Copland Brewery, Toronto, Ont.; Manning Cold Storage Co., Toronto, Ont.; Gunns Limited, West Torouto, Ont.; Harris Abattoir Co., Toronto, Ont.; Davies Co., Ltd., Harriston, Ont.; Moutreal Abattoir Co., Montreal, Que.; O'Keefe & Drew, Chatham, Ont.; British American Brewing Co., Windsor, Ont.; etc. Tbe Armstrong Cork Company bave recently put on the market a new steam covering, made of diatomaceous earth, which is proving highly efficient. A booklet descriptive of the manufacture and performance of the new product is sent free on requeut. The Kent Co., Ltd., Montreal, are sole Canadian agents.

The Canadian P. J. Mitchell Co., St. Francois Xavier St., Montreal, have recently supplied an ice-making machine of the enclosed can type, to McGill University, Montreal. Agitation of the water to be frozen is obtained by means of a screw propeller revolving at the top of the can. The water in whicb the propeller revolves is above the brine level, and, therefore, remains liquid, a condition and arrangement which is particularly effective in trapping a large percentage of the impurities of the water. The plant will be located in Dr. Barnes' laboratory in the Physics building, where so many notable ice experiments have been carried ou. The Canadian P. J. Mitchell Co. have also recently supplied a Sterne refrigerating plant to C. R. Harris & Sons, Toronto.

CLASSIFIED ADVERTISING

FOR SALE

BELTING FOR SALE—800,000 FEET OF best quality leather, rubber, hair and canvas belting, bought from bankrupt manufacturers at 25% to 75% less than the regular value. Also a large quautity of slightly used belting, piping, chains, rails, pulleys, hangers, cotton waste, etc., at very low prices. Send for catalogue. Imperial Belting and Supply Co., 5 Queen Street, Montreal.

WANTED

LARGE EUROPEAN CONCERN, MANUFACturing water turbines, centrifugal pumps and steam turbines, wants to be represented in Winnipeg and Vancouver, by well-known, qualified and experienced firm. Apply Box 111, The Power House, Toronto.

WANTED—EVERY POWER HOUSE IN Canada to remember that C. E. Shedrick, Craig Street West, Montreal, is still repairing measuring instruments, both switchboard and portable. Twenty-five years' experience in repairing all kinds and makes on tbe market. Intregating meters repaired, tested and sealed, and returned on quick time.

SALESMEN WANTED

LAKE ERIE BOILER COMPOUND CO. REquire a few first-class representatives to sell their well-known compound. Liberal commission paid to live men, and exclusive territory. Write at once, giving references, 11 Colborne St., Toronto. (tf)

SITUATIONS WANTED

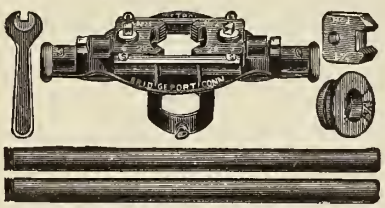
ELECTRICAL ENGINEER, NOW IN CHARGE of operating department of large power company, wants change. Experience with 10,000 v., 3-phase, 50-cycle overbead and underground mains and sub-stations. Box No. 115, The Power House, Toronto.

SALESMAN'S POSITION, EXPERIENCE IN Canada and England. Steady and reliable, age 34, engineering or electrical specialty preferred. Highest recommendation. Address, J. Snowball, 1023 Second Avenue E., Owen Sound, Ont.

MISCELLANEOUS

MODERN FIREPROOF CONSTRUCTION—Our system of reinforced concrete work—as successfully used in many of Canada's largest buildings—gives better results at lower cost. "A strong statement," you will say. Write us and let us prove our claims. That's fair. Leach Concrete Co., Limited, 100 King St. West, Toronto (tf)

U.S. BARKEEPERS FRIEND
METAL POLISH
USED AND ENDORSED BY THE LEADING DEALERS
SOLD ALL OVER THE WORLD



GENUINE
ARMSTRONG STOCKS
AND DIES
FOR CUTTING PIPE & BOLTS
ARE THE BEST.

PIPE MACHINES
PIPE CUTTERS
HINGED PIPE VISES
RATCHET ATTACHMENTS

Manufactured by
THE ARMSTRONG MFG. CO.
298 Knowlton St.
BRIDGEPORT, CONN.
NEW YORK CHICAGO
Catalog mailed on request

LUBRICATION is to machinery what nourishment is to the human body.

Confine the body to a liquid diet and it becomes insufficiently nourished.

Lubricate your machinery with oil alone and you never attain perfect results.

Dixon's Flake
GRAPHITE
"The world's most perfect lubricant."

becomes pinned to the minute metal projections and fills up the microscopic depressions existing in all metal surfaces. It forms smooth, durable, veneer-like surfaces of its own and makes a graphite to graphite, instead of a metal to metal, contact. Sample 222-C and "Graphite as a Lubricant" sent free. Write.

JOSEPH DIXON CRUCIBLE CO.
Jersey City, N.J.

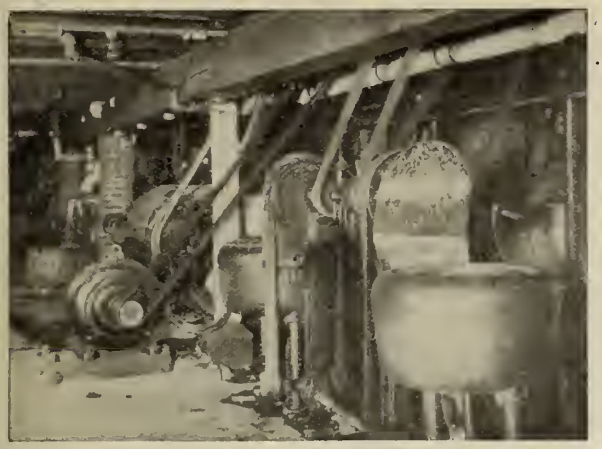
THE
Forbes Motor Driven
PIPE CUTTING AND
THREADING MACHINE

has all the advantages of the belt driven type, with compactness, power-saving and unusual operating convenience in addition. The motor is concealed inside the base of machine, the various speed changes are under lever control: no friction losses, no wasted power.

The absence of countershafts permits heavy lengths of pipe to be handled with cranes or overhead trolleys, or the machine can be taken to the work.

Full description on request. Write us.

The Curtis & Curtis Co.
26 Garden St. - Bridgeport, Conn.



Don't Wait for Trouble Apply Cling-Surface Now

If you merely keep Cling-Surface on hand to be occasionally slapped on cold with a paddle where a belt squeals, don't expect wonders or conclude that the benefits are over-rated. Cling-Surface on the shelf is worth its cost only, and although unequalled as a surface application to stop temporary belt slip, Cling-Surface reaches its FULL VALUE only when it is used as a basis for SCIENTIFIC, SYSTEMATIC BELT TREATMENT.

Cling-Surface used right is bound to prove of daily value. The more extensive its use, the more troublesome and difficult the belts to which it is applied, the more noticeable the results. Experience proves that spasmodic cold treatment of a belt surface is not nearly as effective as systematic hot Cling-Surface treatment of the whole belt. Apply it hot. If your doctor advised a hot foot bath you wouldn't use ice water. Treat the belts with equal intelligence. Belts so treated are proof against moisture, steam and acid fumes, and will pull their full loads perfectly throughout the longest possible life.

The absence of slip after Cling-Surface treatment invariably enables a belt to pull a greater load with smaller bearing friction loss, and by rendering initial tension unnecessary, relieves pulleys, bearings, shafting and even the engine to an extent that means much in reduced repairs, labor, lubrication and fuel consumption.

Giving your belts the serious attention they deserve involves at least a trial of Cling-Surface. Make the test and your only regret will be that you did not do so sooner. Ask for our literature and liberal offer on a trial order.

Cling-Surface Co

1057 Niagara Street Buffalo N Y

40

If you want a leather belt which will stand ANY test as to its being proof against water, other liquids or moisture-laden atmospheres, you should specify

"AMPHIBIA"

(WATERPROOF)

Leather Belting

Made by

Sadler & Haworth

Tanners and Manufacturers

MONTREAL
511 William St.

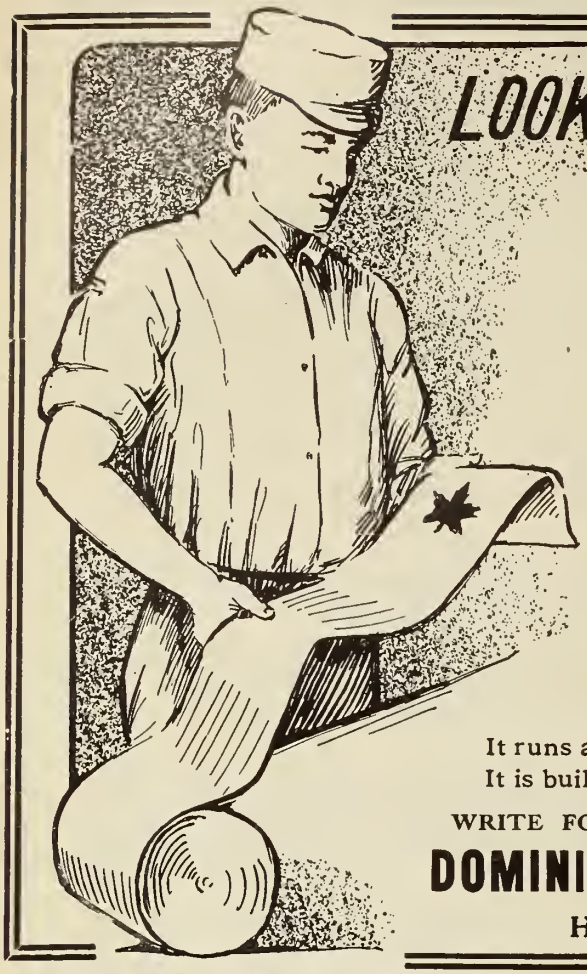
TORONTO
27 Melinda St.

ST. JOHN, N.B.,
89 Prince William St.

WINNIPEG,
244 Princess St.

VANCOUVER,
217
Columbia Ave.

The advertiser would like to know where you saw his advertisement—tell him.



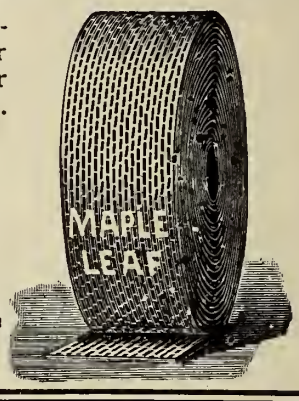
LOOKING FOR THE "MAPLE LEAF"

is increasingly a habit with those who buy much Belting.

The reason is not hard to find, for there is no part of your Belting system, from the main drive to the smallest light Belt for power transmission, where you will not get the best kinds of service from

"MAPLE LEAF" BRAND
Stitched Cotton Duck Belting

It is the most economical Belting because it is durable under every condition; even where other Belting will deteriorate rapidly. It is water proof.



It runs absolutely true on the Pulleys.
It is built of plies of selected duck.

WRITE FOR INFORMATION AND PRICES

DOMINION BELTING CO., Ltd.

HAMILTON, CANADA

"STICK TO THE SOLID STICK"

We'll Send You a Half-Pound Free

This is OUR way of proving to you the advantages of STEPHENSON BAR BELT DRESSING over liquid or semi-liquid dressing. The price of the stamp you use in writing us entitles you to make an important test in your own plant, at our expense. STEPHENSON BAR BELT DRESSING takes effect instantly, as soon as it touches the belt. No waste, spattering, muss—nor any other troubles. "STICK TO THE SOLID STICK" and you can show a saving in oils, greases and belt expense. Write for the free half-pound sample TO-DAY.

WHAT ENGINEERS THINK OF THESE HALF-POUND SAMPLES

"It is the first bar belt dressing I have used that makes the belts work properly."

"I found your dressing all O. K. I have asked my company to buy me a 12-lb. box."

"I received your sample of belt dressing and wish to say I think it is all you claim for it. After using a small quantity of your dressing for a couple of weeks we can now use our belts slack, without any trouble from slipping.

NONE GENUINE WITHOUT TRADE MARK

Stephenson Manufacturing Company

Established 1888 — Albany, N. Y. — Incorporated 1897

The advertiser would like to know where you saw his advertisement—tell him.

LEVIATHAN

HIGH QUALITY BELTING

Main Drives a Specialty

BELTING SERVICE

Here is the "Why"

CUT THIS OUT

Leviathan Belting is scientifically conceived and made. By that we mean it is made to *effectively meet requirements.*

These are they:

First, traction: Leviathan is coated and impregnated with a preparation which gives tremendous traction and makes it possible to deliver the power with a "slacker" belt than is feasible with other makes or kinds. Second, durability: It is so treated that constant wear and tear has the minimum effect upon it. Third, proof against adverse surroundings: It is so treated that its environment—whether hot or cold water, steam, and many gases—will not affect it. Fourth, proof against stretching: Canvas in long lengths, specially made and carefully folded and stitched, so treated by our exclusive process that the maximum amount of stretch is eliminated.

What is the result? A *dependable*, long wearing, efficient belting, low in initial cost and wonderfully low in the "long run" cost.

We have a little book telling about it. Fill in your name and address, and we will mail it to you. Also write particulars of any belt you want.

Main Belting Company of Canada, Limited

41 Common Street, MONTREAL

20 Wellington St. West, TORONTO

WE REQUIRE A BELT FOR TRANSMISSION

and will wish delivery about.....
Size of belt.....' long by....." wide.
Dia. Driving Pulley.....
Dia. Driven Pulley.....
Approximate H.P.....
Revolutions of Driving Pulley.....

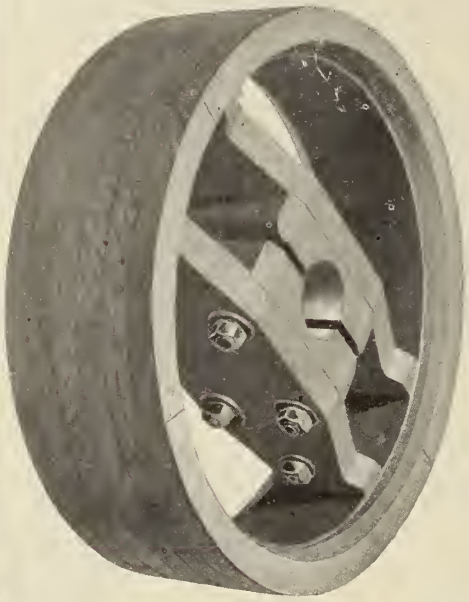
If the belt is used crossed, at quarter turn, with idler, or subject to any unusual conditions, including extreme heat, moisture, gas or oil, we state below.

....

Name.....

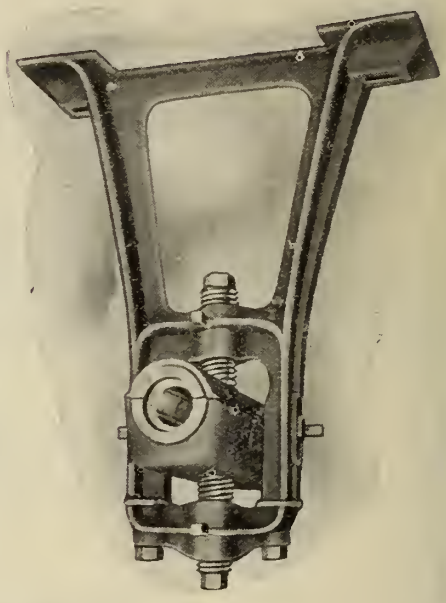
Address.....

A Combination Hard to Beat



Elmira Ball and Socket Hangers

Elmira Wood Split Pulleys



The Elmira B. & S. Hangers are designed to meet the hardest and most exacting conditions. They are of good weight, correct design, and well proportioned. A Duplex system of oiling is employed consisting of tempered steel rings and woven cotton wick.

The Elmira Pulley is built to stand the hardest service and most severe conditions. The rim is nailed throughout. The arms are tenoned into the rim and dowelled there. The pulley is guaranteed to run wherever a leather belt will give satisfaction.

Send for our Illustrated Catalogue "C."

Large and complete stocks carried at Elmira, and by

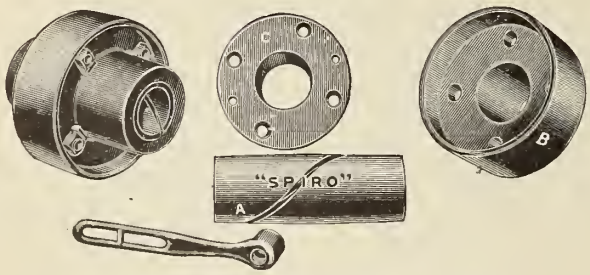
The A. M. ELLICOTT CO., 301 St. James Street, Montreal, Que., Sole Eastern Agents.

Elmira Machinery & Transmission Co., Limited - - Elmira, Canada

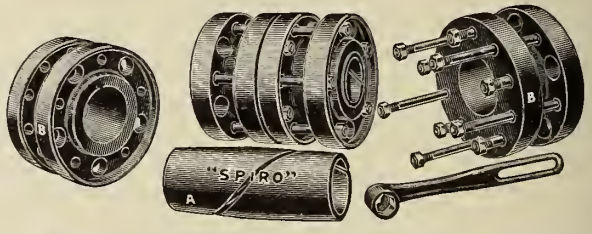
Make Your Assurance "Double Sure" and Grip Your Shafts With

THE BOND PATENT "SPIRO"

Compression Coupling



Single Flange up to 2 15/16.



A—Sleeve. B—Shells.

Double Flange above 2 15/16.

50% more gripping power than any other coupling on the market.
Catalog "Y," showing complete line of power transmission appliances,

SENT ON REQUEST

CANADIAN BOND HANGER & COUPLING CO., LIMITED

MANUFACTURERS

ALEXANDRIA, ONTARIO

The advertiser would like to know where you saw his advertisement—tell him.

BELTING.

What Do You Know About "Lanco" Balata Belting?

The average man who uses belting has very little idea as to what Balata Belting really is. He knows it is a textile belt, but little more. The compound used in making the genuine Balata belt is obtained from the tree known as the Boela tree, which grows in South America. From this tree a gum is obtained similar to that from which rubber is made, and when the gum was first noticed by Europeans, they thought it was rubber. They were surprised to find, however, that it would not vulcanize.

This gum was at first deemed worthless, but the very thing that makes this gum of no use as rubber, makes it very valuable in a belt.

Balata belts will not crack, vulcanize or become hard with age. Any belt user knows the advantage of this.

Not all the Balata Belting sold is made of the pure gum, and in such cases the belting is often inferior. "Lanco" Genuine Balata Belting is guaranteed to be filled with pure Balata Gum, and the best quality of canvas is used as a base.

Write us about Balata Belting—every inch guaranteed.

Federal Engineering & Supplies, Limited

Head Office, 284 Yonge St., TORONTO **Branch Office, 329 St. James St., MONTREAL**

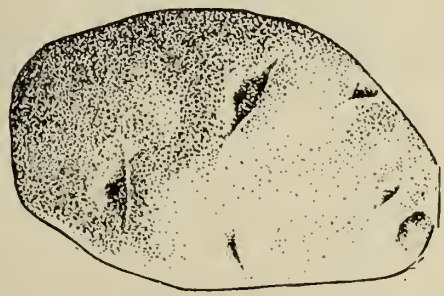
Potato Scale Boiler Cleanser

Works With Certainty

Send me a gallon of your feed water, we will analyze it and mix you a compound that will not only remove old scale, without the slightest injury to the tubes, but will prevent any fresh scale from forming.

Give it a fair trial and if it doesn't do what I claim, I will cancel the charge for the amount.

WRITE AT ONCE.



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WE GUARANTEE

WALKER'S ELECTRIC BOILER COMPOUND

To Remove all Scale or Incrustation

from your boiler without injury to Irons, Packings or connections. Its composition consists of ingredients that are absolutely harmless to metal. Let us prove its effectiveness by sending you a sample on trial.

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The Electric Boiler Compound Co. Limited

GUELPH - ONTARIO

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So stated a member of the U.S. Geological Survey, dwelling further upon the harm that results from the use of wholly unsuitable materials in "ready made" compounds which are frequently so great as to offset all the good the compound might do.

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GALLON OF WATER NEEDED FOR ANALYSIS.

Dearborn Drug & Chemical Works

McCormick Building - Chicago

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Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

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McCOLL'S Special Boiler Compounds

or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

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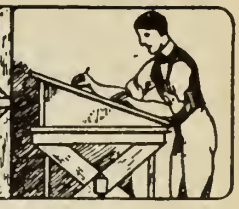

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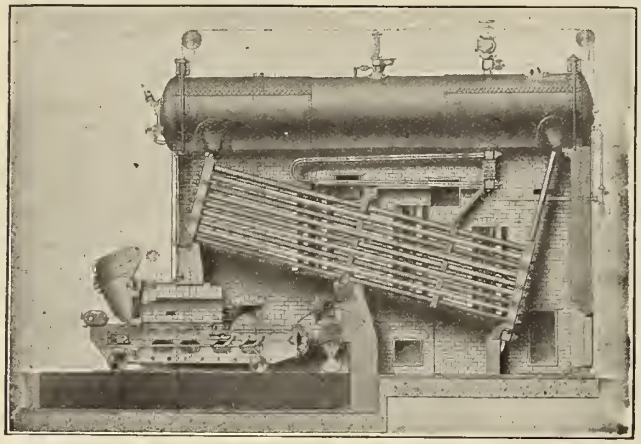

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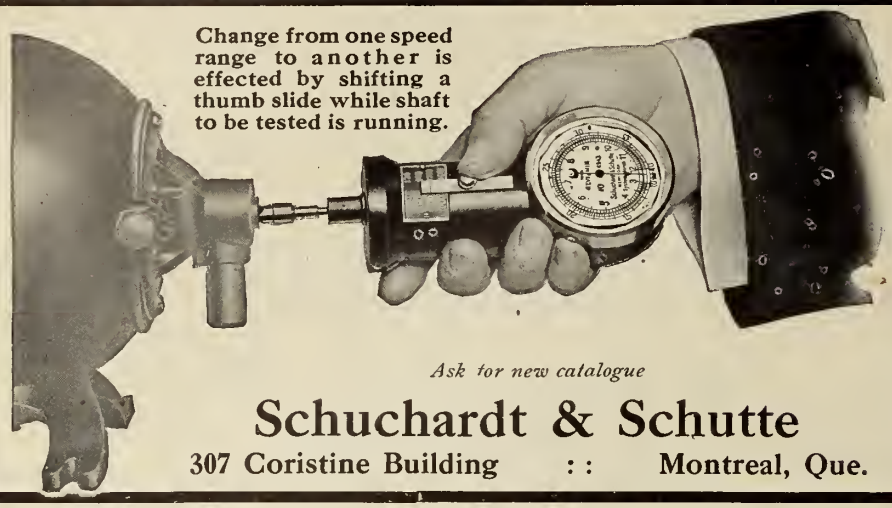

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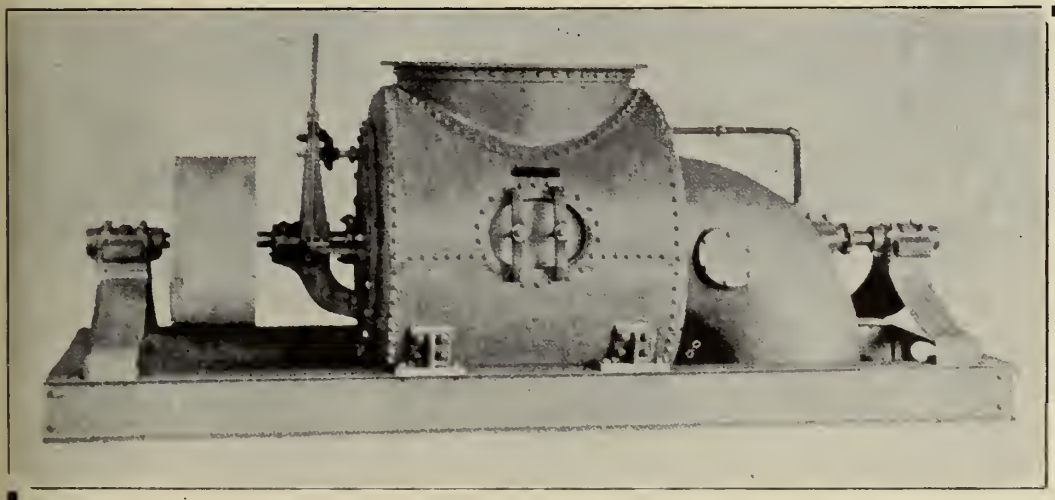

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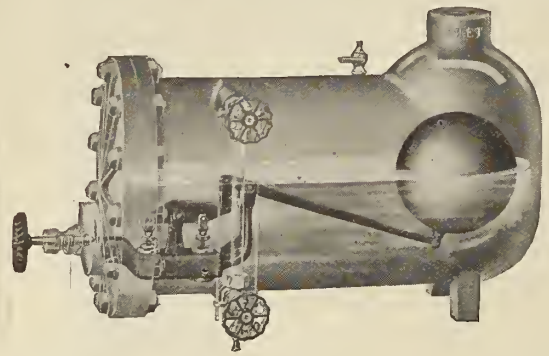

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Westinghouse Line Material

Designed with a liberal factor of safety which insures against failure under all adverse conditions it is necessary to provide against. The efficacy of the three devices illustrated is typical of the complete line.

The Westinghouse Detroit Trolley Frog

Used on any turnout regardless of the degree of curvature. Bodies are made of malleable iron or bronze. Long, flexible bronze approaches prevent the trolley wheel striking a blow, and avoid crystallization of the trolley wire.

Note the groove in the pan of the frog. This steadies the trolley wheel and prevents it accidentally taking the turnout when travelling on the tangent at high speed. The span is short and the trolley wheel travels a minimum distance on its flanges.

The Westinghouse "KB" Section Insulator

A smooth, straight under run is secured. The insulation is impregnated, straight-grain hickory wood. All wearing parts are renewable. End castings are bronze and fitted with feeder lugs for feeder or jumper attachment.

The runner is fibre and fitted with bronze arcing tips. Flexible bronze approaches are used, the same as furnished with the Detroit Frog. Tapered sleeves, the same as those in the Cleveland Splicer, are used to hold the wire.

The Westinghouse Cleveland Trolley Splicer

Makes connection quick and easy. The bronze composition used has a maximum strength and long wearing life. Furnished with or without removable boss. Same design of approach used for either round or grooved wire.

Threaded and slotted tapered sleeves fit around the wire, and, when inserted in the conical hole in the splicer casting, grip the wire firmly. The greater the pull the firmer the grip becomes.

Canadian Westinghouse Co., Limited, Hamilton, Ont.

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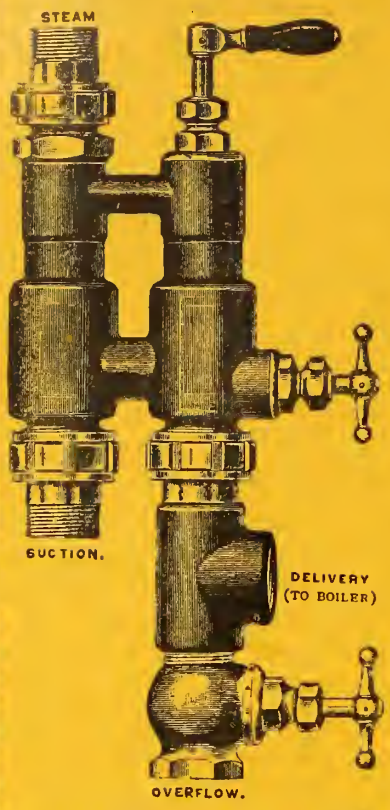
Traders Bank Bldg.	52 Victoria Square	Telephone Bldg.	158 Portage Ave. E.	311 8th Ave. W.	Bank of Ottawa Bldg.



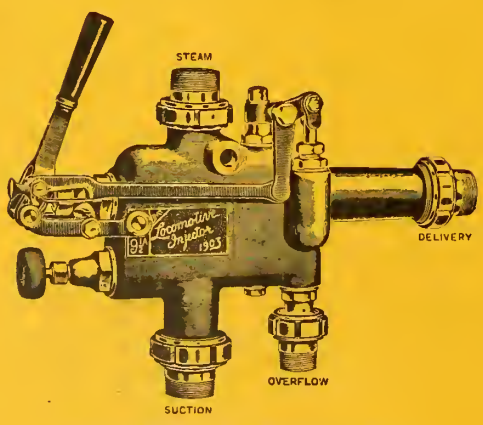
HANCOCK INSPIRATOR

Use only the genuine for best results.

Morrison's Engineers' Supplies

Quality Guaranteed

Many Engineers prefer the Inspirator type of boiler feeder to the injector. It contains two sets of tubes or jets, where the Injector has but one set. Each set fulfilling its duties of lifting and forcing, making a more durable and efficiency-lasting machine; it requires no adjusting or throttling of valves due to any variation in pressure, feeds boiler at highest temperature limit, and makes the best "all-around" boiler feeder on the market.



LOCOMOTIVE INJECTOR

HANCOCK TYPE

A single lever movement operates machine.

HANCOCK EJECTOR

For lifting liquids of all kinds by steam pressure.

J. M. T. VALVES

When you want a really good valve ask for J.M.T. All engineers recommend them.

The James Morrison Brass Mfg Co., Ltd.

93-97 Adelaide Street West, TORONTO

Special Feature—Articles on Power Transmission

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-149 University Ave. LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. V. Publication Office, Toronto—April, 1912 No. 4

Penberthy Automatic Cellar Drainer

ADVANTAGES OVER OTHERS:

All parts above water. Takes up one-third the space. Weighs about one-quarter. Costs less to install. Instantly accessible without disconnecting pipes or removing drainers.

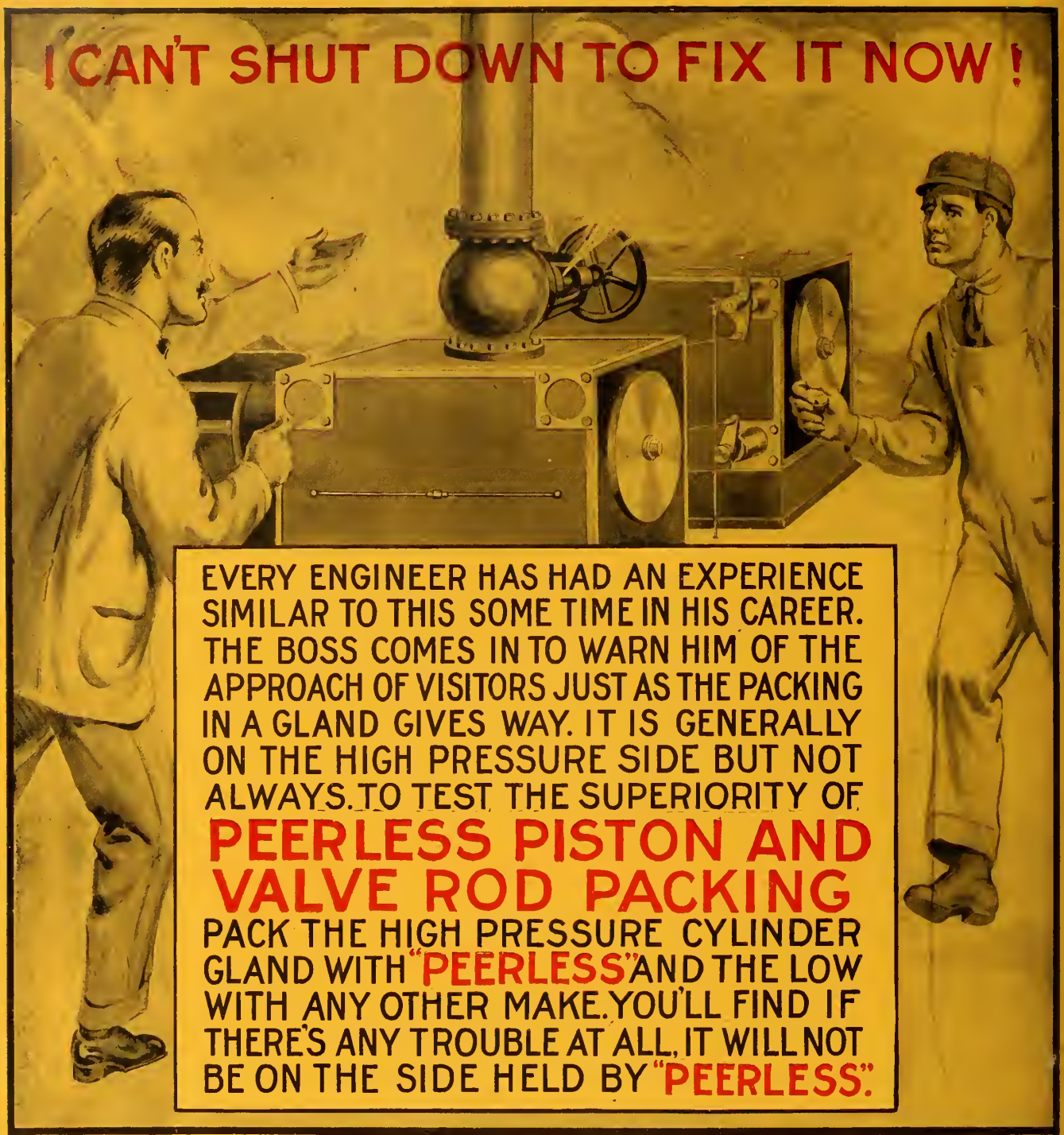
THE PENBERTHY Automatic Cellar Drainer is a Penberthy water pressure ejector of high capacity, automatically operated by a float-controlled, quick-opening-and-closing valve. This valve is never partially opened—it cannot leak, and allows the ejector to give its greatest efficiency by working to full capacity. The float arms are slotted at A, where they connect to the valve lever—this prevents the ejector from operating until the water has raised the float up to the highest point, and, as the water is ejected, they travel down the length of these slots before the weight of the float affects the valve. This allows the machine to work for longer periods and not so often, thus preventing considerable wear and the leakage and dribbling of water, as is so common in the majority of drainers.

To enable the installation of this drainer in small holes, or sumps, we have made it as compact as possible. The float, instead of being round, is flat on the top; it has more buoyancy and occupies less space than a round float of the same diameter. We have further economized on space by building the float around the suction pipe. This patented feature has the added advantage of being rigid and overcomes all the trouble of the common loose float. The balance of the drainer is built directly above the float; this not only keeps the whole machine in as small as space as possible, *but also keeps all working parts, with the exception of strainer and float, above the water,* thus preventing corrosion or the exterior parts becoming clogged up by deposits of slime, dirt or sediment. The interior parts are prevented from coming into contact with any foreign particles by the special strainer, which is so constructed that instead of the water being drawn directly upward, it is taken in at the sides, allowing all sediment to collect under the strainer without being disturbed by the force of the suction. We also provide a foot valve *inside the strainer* which closes the instant the drainer ceases operating, holding all water in the pipes, all primed for starting instantly, at the next filling of the sump.

The Penberthy Automatic Cellar Drainer is particularly adapted for use in pits, sumps, cellars, tanks, settling basins, or wherever it is desired to keep water or other liquids from going above a certain level. It is more efficient, takes up less room, will last much longer and sells at a lower price than asked for many drainers not as efficient. They are made of best bronze metal, except float, which is copper—can be regulated for any water pressure. We will furnish estimates for any special requirements.

MFD. BY **Penberthy Injector Co., Limited. - Windsor, Ontario, Canada**

I CAN'T SHUT DOWN TO FIX IT NOW!



EVERY ENGINEER HAS HAD AN EXPERIENCE SIMILAR TO THIS SOME TIME IN HIS CAREER. THE BOSS COMES IN TO WARN HIM OF THE APPROACH OF VISITORS JUST AS THE PACKING IN A GLAND GIVES WAY. IT IS GENERALLY ON THE HIGH PRESSURE SIDE BUT NOT ALWAYS. TO TEST THE SUPERIORITY OF

PEERLESS PISTON AND VALVE ROD PACKING

PACK THE HIGH PRESSURE CYLINDER GLAND WITH "PEERLESS" AND THE LOW WITH ANY OTHER MAKE. YOU'LL FIND IF THERE'S ANY TROUBLE AT ALL, IT WILL NOT BE ON THE SIDE HELD BY "PEERLESS."

PATENTED AND MANUFACTURED EXCLUSIVELY BY

PEERLESS RUBBER MANUFACTURING COMPANY

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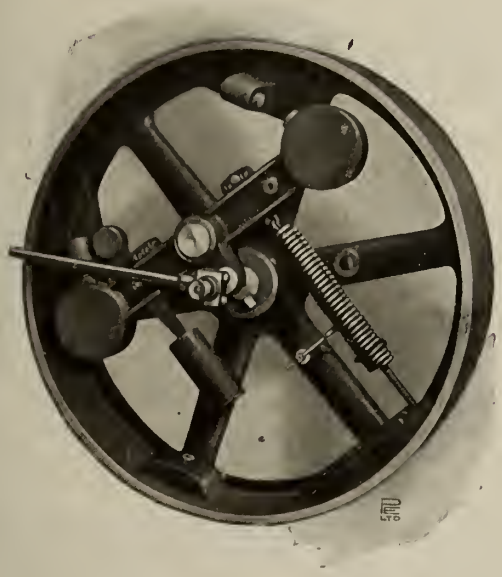
H. D. EDWARDS & CO.

DETROIT - MICHIGAN

Sole Agents and Distributers for the Dominion of Canada

Uniform Speed With a Varying Load

We Guarantee it on the McEwen Engine



Every McEwen Engine we sell is issued with a rock-bottom guarantee that reduced to plain English means "Perfect engine regulation or your money back."

Although there are hundreds of McEwen Engines operating in Canada to-day, we have never been asked to redeem this guarantee.

The Begthrup Inertia Governor is the reason why.

It is simple in construction. It is easy of adjustment. It is carried on a roller bearing that practically eliminates bearing friction. An exceptionally heavy inertia bar provided with dashpot and with helical spring permits an instantaneous action while retaining absolute stability.

The Begthrup Governor can be regulated to speed up under load and still govern perfectly without the least tendency to race or hunt.

With it the McEwen Engine can be adjusted to govern within the limit of one revolution. The entire load can be thrown on or off with an instantaneous variation of speed not more than one per cent. The engine will return to its standard speed with but one vibration and within the space of two seconds.

Along with the perfect regulation this Governor ensures, the McEwen Engine combines simplicity of design, with exceptional strength and accessibility.

Built in Simple and Compound types up to 700 Horse Power.

¶ The McEwen Engine is adapted to all kinds of work. We especially recommend it direct connected to Generator for the economical production of electric power for lighting and driving purposes.

¶ All parts of engine are made to gauge, thereby ensuring perfect fit and interchangeability. Every engine when completed is given a long and severe test under full load and over load. You take no risks when you buy a McEwen.

Catalogue—"The McEwen Engine"—Sent on Request.

The Waterous Engine Works Co., Limited

Brantford, Canada

Every Up-to-Date Plant Should Investigate

The "Stanlock" System

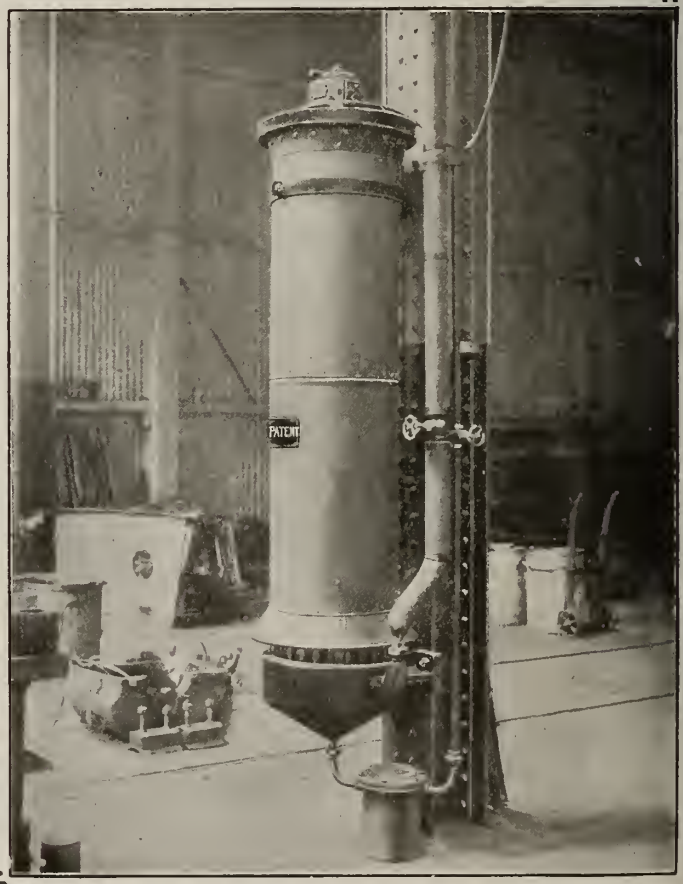
of

Heating and Ventilating

This system consists of units as shown below. They are made of steel tubes screwed into circular cast iron bases and through these tubes steam passes. Enclosing these tubes is a sheet metal cylindrical casting with a motor at the top. The air is forced downwards, thus keeping the floor warm. A special pipe can be fitted, passing through the roof or through the side wall, thus giving a supply of fresh air. Dampers are provided so that the inside air can be circulated or outside air can be taken in and heated.

Advantages of the "Stanlock" Multiple Unit System

1. No overhead air ducts are required.
2. No underground masonry ducts are required.
3. No obstruction to light due to overhead air ducts.
4. No heat losses due to radiation from air ducts.
5. Minimum of power absorbed.
6. Units hung on walls. No floor space needed.
7. Various units operated independently and can be turned on or off like radiators. Some supply fresh heated air and others merely circulate and heat.
8. A unit using 60 lb. steam pressure heats 3,600 sq. ft. of floor space.
9. The first cost of apparatus is very low.
10. Units may be added at any time in case of extensions, and in case of boiler shops, units may be removed entirely during the summer months, if desirable.



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Selling Agents for the Dominion of Canada

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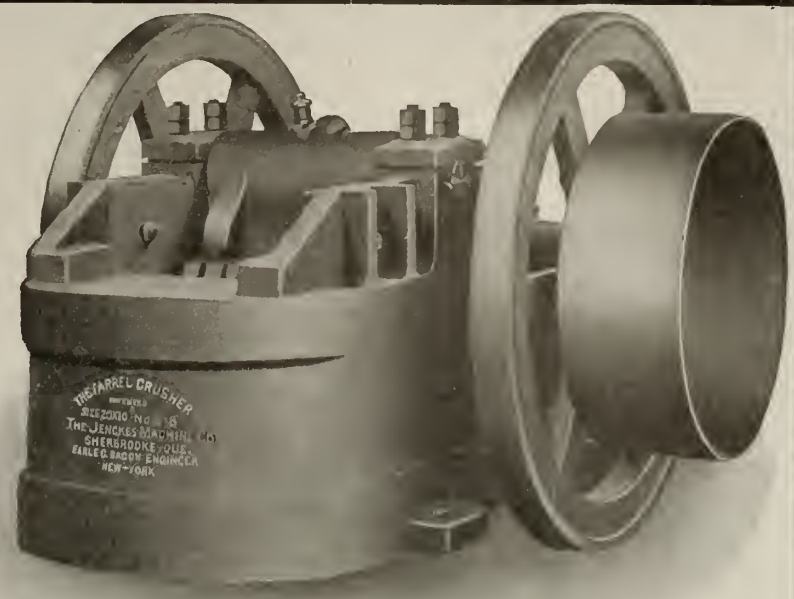
Crushing Machinery

Crushers, Crushing Rolls,
Fine Crushers
and Accessories.

Complete Crushing
and
Screening Plants,
including
Power Equipment.

Write for Catalog.



The Jenckes Machine Co., Limited

General Offices: Sherbrooke, Que.

Works: Sherbrooke, Que. St. Catharines, Ont.

Sales Offices:—Sherbrooke, St. Catharines, Montreal, Cobalt, So. Porcupine, Vancouver, Nelson.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

W. A. CROCKETT

Executive Secretary

MT. HAMILTON, - - ONTARIO

These are the telling points about

Bakelite

Valve Discs

They will not leak under high temperature, excessive pressure or when used in acids or other special liquids. Neither cold water, dry or superheated steam has the least effect upon them. BAKELITE Discs are a gas-tight fit.

BAKELITE is a successful substitute for expensive metal. Its structure is fibrous, giving strength and hardness. It can be reground and refaced, always retaining a uniform surface. It cannot be injured except by accident or friction.

Remember Bakelite PUMP VALVES do not warp with changes of temperature.

Order your valves fitted with Bakelite Valve Discs and stop that perpetual annoyance and expense caused by leaking valves. Depend upon it, Bakelite Valve Discs will not leak.

WRITE FOR PRICES OR ASK YOUR DEALER.

PLASTICS, Limited, - Van Horne St., TORONTO

The advertiser would like to know where you saw his advertisement—tell him.

Use Goodyear Non-Chip, Rot-Proof Hose

A Few of the Lines We Manufacture.

Don't tie up money in hose that begins to need repairs after a ***few weeks'*** use.

Buy the only dependable, never-mend hose—

GOODYEAR Water Hose

Built by World's Greatest Hose Experts for Pulp and Paper Mills, Manufacturers, Boiler Rooms, Flushing and Garden Use and All Uses Where Cold Water is Carried

The strongest, longest lasting hose made.

Goodyear Hose is built on principles that years of experience have proved most practical. The fabric is cut on right bias to give greatest strength and endurance and to resist expansion and elongation—one of the prevailing faults of common hose.

Only highest grade material used. Rot-proof, because specially treated and covered with heavy, durable canvas that can't chip off and expose tube to weather.

Can be furnished with round, half-round or flat wire winding or Marlin wind.

Steam Hose—Air Hose—Suction Hose

We manufacture highest grade hose for every purpose. Used throughout the Dominion. Wherever used, is ***saving money.***

All Goodyear products built according to same methods employed by Goodyear Tire & Rubber Co., Akron, Ohio—one of the best known and most successful rubber goods manufacturers in the United States.

Our sales of the last four months 50 per cent. greater than those of last year. Defective goods returned only $23.93.

Tell us your requirements. Let us send catalog. Write to-day.

The Goodyear Tire & Rubber Company of Canada, Ltd.

General Offices—Toronto Factory—Bowmanville, Ont.

Write Our Nearest Branch

BRANCHES: Montreal—Winnipeg—St. John, N.B.—Vancouver—Calgary
Victoria, B.C., 855 Fort Street; Regina, Saskatchewan, 2317-2318 South Railway Street; Hamilton, Ont., 127 King Street West

12

GOETZE'S VALVE GASKETS SAVE TROUBLE AND MONEY

THEY ARE FOR VALVES OF THE JENKINS TYPE
AND ARE MADE OF COPPER AND ASBESTOS

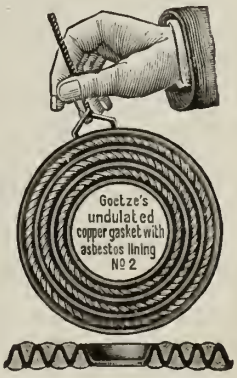
One Goetze's Valve Gasket will outlast six rubber discs, because it will not crack and go to pieces as rubber does. That's why Goetze's Valve Gaskets are cheapest from beginning to end.

Order your new valves fitted with Goetze's Valve Gaskets and have no more trouble with leaks. Use Goetze's Valve Gaskets to give your old valves a new lease of life. Only be sure you get *Goetze's.*

That Joint That Gives You So Much Trouble Can Be Made *Tight*

To put a gasket on the least troublesome flange joint in your plant is no real test of the value of that gasket. Put it on the *worst* joint, the one that is always giving you trouble, and you'll find out whether it is any good for your purpose or not.

We tell you that you can put a complete stop to all trouble due to leaky flange joints, that you can make that joint which gives you so much trouble absolutely tight



By Using Goetze's No. 2 Gaskets

And we are willing to prove it to you by shipping you any quantity on *90 days' trial*—no charge if they do not make tight joints and *hold* them tight under all pressures and temperatures. Try them. Write us to-day what sizes and quantities to ship. Remember, they do not cost you a cent unless they do the work. And be sure to ask for a copy of our Illustrated Catalog of Packings for all Power Plant Purposes.

Goetze Gaskets are carried in stock by

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MANUFACTURED BY

Goetze Gasket & Packing Co.

NEW BRUNSWICK, N.J.

The advertiser would like to know where you saw his advertisement—tell him.

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY

"John, How Are We Going to Live?"

The increasing cost of living is worrying the heart out of many an engineer's wife. Likely this is the experience of your wife or mother. You, of course, can not reduce the cost of meats and groceries, but **YOU CAN EARN MORE.** And you can do it by learning how to operate your own plant at less cost. Most "bosses" are willing to advance the men who save them money. Our Blue Book has helped many engineers to increase their wages. Your FREE copy will be sent when you comply with the simple requirements stated below.

How to get the Hand-book FREE

Fill out the Coupon and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and look at Daniels' P.P.P. Packing.

YOUR NAME. .....
ADDRESS .....
EMPLOYED BY .....
ADDRESS .....
HORSEPOWER OF ENGINE .....
KIND OF ROD PACKING USED .....
DO YOU USE EBONITE SHEET PACKING? .....
BUYER'S NAME .....
DEALER'S NAME .....
ADDRESS .....
..... Series 24-D

If your dealer doesn't carry P.P.P., we will write telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

P.P.P. Was the First REAL Improvement in Rod Packing and It Has Been the Last.

This packing was the result of years of study and experiment. That it is constructed on the right principle has been proved by a long series of scientific tests and years of practical use.

Daniels'

P. P. P.

Rod Packing

The engineer who uses P.P.P never has "packing troubles," and he can show his "boss" that P.P.P. does save from $100.00 to $500.00 a year on coal bills. Our Packing Expert will write you a letter proving this claim, if you will show it to the "old man." It will help you make good.

THREE STYLES

"Regular," "Special" and "Marine." All styles are furnished in Coil, Spiral and Ring forms.

FREE To Users of P.P.P.

If you are a user of P.P.P., fill out the coupon and mail it to us. We will send the Engineers' Examination Book to your dealer (or one we name) who will hand it to you when you call at his store and look at Daniels' EBONITE Sheet Packing.

To better protect P.P.P. users against imitations, we have adopted a red "D" with a **diagonal line across it.**

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

PHILADELPHIA, PA., U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

YEARS OF EXPERIENCE

Convinces others of the **Superior Qualities** of Garlock Packings.

You will save much by taking a short cut and using them **now.**

TRADE THE GARLOCK PACKING CO. HAMILTON, CANADA. MARK

This design is the registered Garlock Trade-Mark, and stands for the highest standards of quality and service possible to obtain in the manufacture of Packings.

—— LOOK FOR IT ——

The Garlock Packing Co.

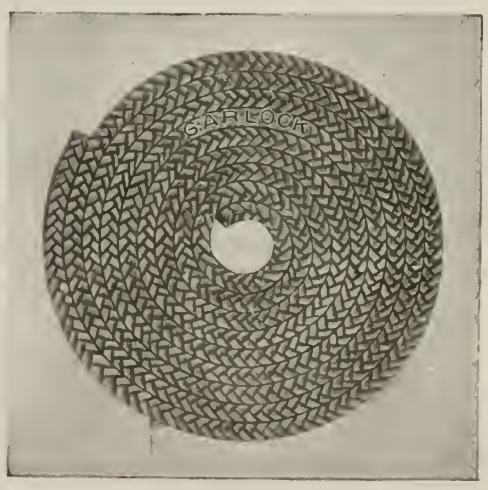
Head Office and Factory:
HAMILTON - ONTARIO

Branches:
Montreal Toronto Winnipeg

"Pioneers in the Packing Business."

Garlock Low Pressure Diagonal

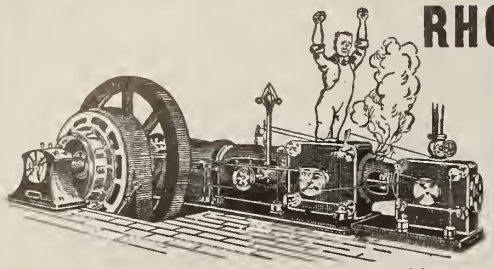
Garlock Gum Gore



Garlock Square Flax

Write for Catalogue showing "Packings for Every Purpose."

RHODES IMPROVED METALLIC PACKING

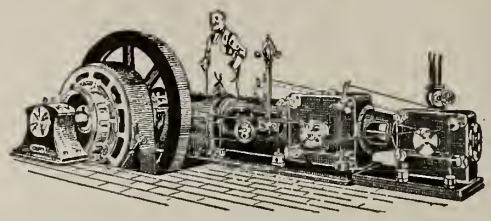


This was BEFORE he used our packing.

THE PACKING THAT PACKS

A trial will convince you.

Beware of Imitations.



This is AFTER he installed our packing.

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited

55 St. Francois Xavier Street, - - - MONTREAL

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

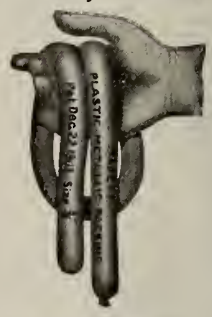
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

Practically Frictionless



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The ASBESTOS & RUBBER GOODS CO.

TORONTO, Ont.
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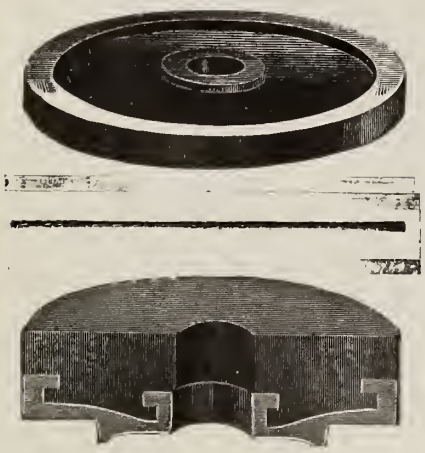
MONTREAL, Que.
43 St. Francois Xavier Street,

L. R. & B. PUMP VALVES



Give better service than any other, and last longer.

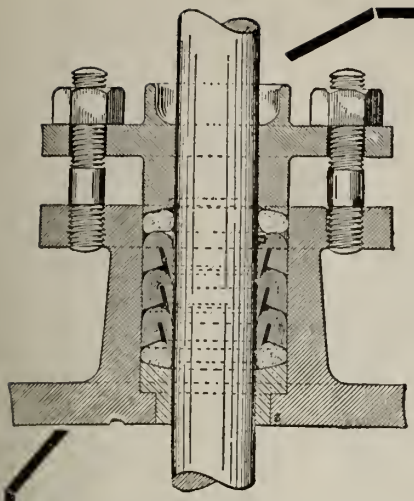
Brass Casing prevents ports from forcing through.

Only best quality of material is used, and as wear takes place the rubber can be replaced until brass casing is reached, thereby giving full use of all the rubber.

It only needs a trial to convince you.

We also carry a full stock of all other engineers' supplies.

Write us before placing your orders.



Friction, Leakage, Waste Power Practically Overcome With

J-M Sea Rings

With this ideal Automatic Piston Rod and Plunger Packing, friction is practically eliminated, leakage entirely prevented and waste energy avoided. It effects a considerable saving in fuel, and is the most efficient, durable and economical piston rod packing on the market.

As every engineer knows, there is practically no pressure through the stuffing box during the forward stroke of piston, and a variable pressure, ranging from initial to atmospheric or lower, on the return stroke.

The amount of pressure J-M Sea Rings exert on the rod is in direct ratio to the pressure through the stuffing box—never more nor less—because they require pressure behind their lips to force them against the rod. And as this pressure drops off in the gland end of the cylinder, the pressure of rings on the rod diminishes.

Compare the action of J-M Sea Rings, which automatically exert and release their pressure on the rod, with the old type of packing which grips the rod constantly, or in plainer words, acts as a brake consuming an enormous amount of power.

J-M Sea Rings possess many other good features, all of which are described in our Blue Book.

Your copy awaits you on request to our nearest branch.

THE CANADIAN H. W. JOHNS-MANVILLE CO., Limited

Manufacturers of Asbestos and Magnesia Products

TRADE ASBESTOS MARK

Asbestos Roofings, Packings, Electrical Supplies, Etc.

TORONTO, ONT. MONTREAL, QUE. WINNIPEG, MAN. VANCOUVER, B.C.

1503

A STEEL GASKET

For Water Tube Boilers

The (Double R.-R.) Gasket

Made In Canada

We are the Sole Manufacturers in Canada of the Steel Asbestos Gaskets.

Mr. Engineer!

No more plates to clean, there is nothing in a steel gasket to melt or burn, and stick to the plates, just a steel shell filled with an asbestos cord. Cheaper and better than any other Gasket on the market.

Write for free sample, naming the make of boiler.

CANADIAN GASKET CO.

BRIDGEBURG, ONTARIO

Corrugated Copper Gaskets of all kinds.

YOU WANT TO IMPROVE YOUR POSITION

THEN READ THE

LIFE OF JAMES WATT

INVENTOR OF THE STEAM ENGINE

By ANDREW CARNEGIE

An entertaining book for those interested in mechanics and power, dealing with the scientific and mechanical inventions of Watt's life and times and his relations with other noted scientists and inventors.

The author, as a practical engineer, possesses all the technical knowledge necessary to give actuality to his writing, and his book is alive with enthusiasm and appreciation. He has missed no point in the romance of Watt's career, with its many thrilling episodes and its study of human nature revealed in a realistic manner. Mr. Carnegie may not point out how to become a millionaire, but he certainly sets forth considerations which may help to influence many a working man to improve his position.

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TECHNICAL BOOK DEPARTMENT

MacLean Publishing Co. - 143-149 University Ave., Toronto

SHOWING HOW SCALE ACCUMULATES IN A CLOSED OR PRESSURE HEATER AND THE EVIDENT DIFFICULTY OF REMOVING IT

Instead of Retubing Your Closed Heater Buy a Cochrane

THE manager of a large furniture factory told us recently that seven years ago he bought a closed or tubular heater, on the guarantee that if the tubes gave out they would be replaced free of charge. This heater originally had steel tubes, but in the course of seven years it had been retubed twice, and at present copper tubes are used.

The cost of retubing with copper tubes would go far towards the price of a Cochrane Open Feed Water Heater, which never requires tubing, simply because it has no tubes, the steam coming in actual contact with the water.

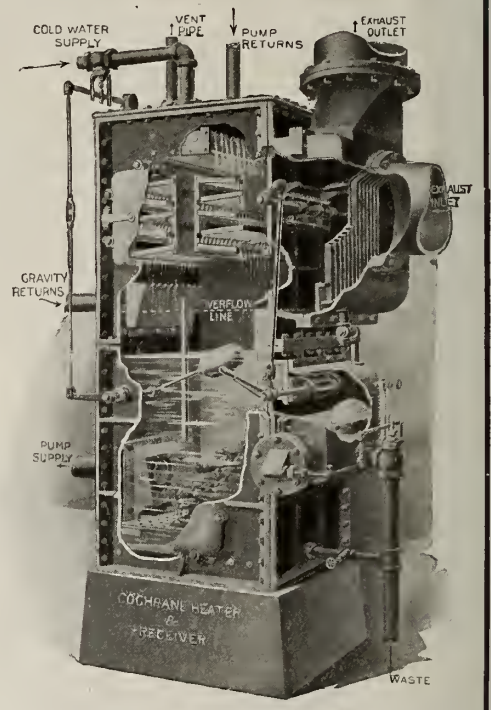
The Cochrane Heater is the more economical in its upkeep, and also saves more fuel. **With six pounds of raw water and one pound of exhaust steam it produces seven pounds of feed water, heated to 210° F.**

The closed heater, on the other hand, requires 7 pounds of raw water and 1⅛ pounds of steam, and even then the temperature is rarely more than 180 or 190° F., due to the fact that **the heat must be transmitted through the metallic surfaces, and probably also through scale and oil coatings deposited thereon.**

Further, the Cochrane Open Feed Water Heater performs a number of functions impossible with the closed heater, serving as hot well or return tank, feed water purifier and filter, and raw make-up water regulator.

Where there is a surplus of exhaust steam which can be used in a heating or drying system, or in a low pressure turbine or absorption ice machine, the Cochrane Steam-Stack and Cut-Out Valve Heater and Receiver is invaluable.

By saving the additional cost of an independent oil separator installed in a by-pass around the heater, together with trap to drain the same, valves and fittings, this apparatus reduces the original cost of equipment by from $50 to $500, depending upon the size of the plant.



INTERIOR VIEW OF COCHRANE STEAM-STACK AND CUT-OUT VALVE HEATER AND RECEIVER

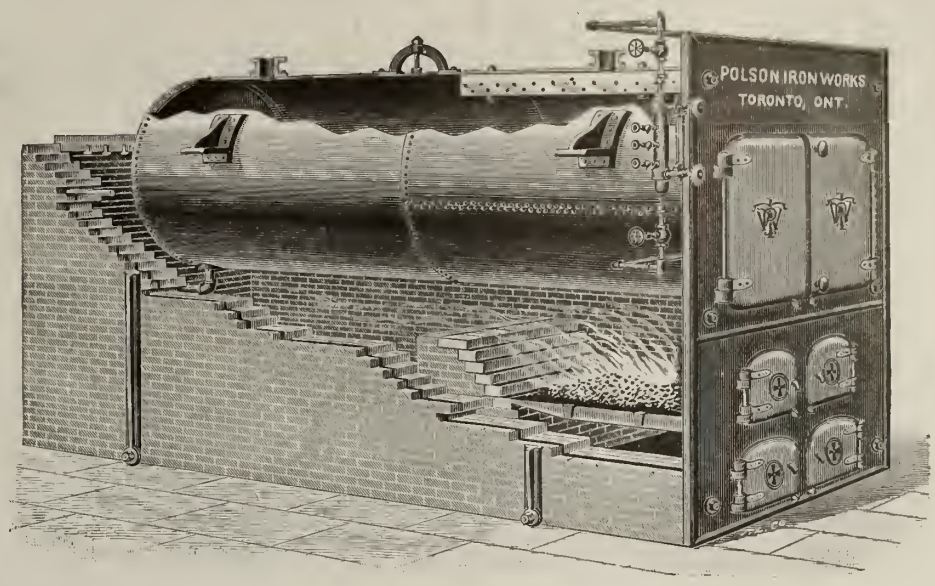
When ready to purchase a new feed water heater, send for our treatise on "**The Profitable Utilization of Exhaust Steam,**" or if you are interested in heating, for our "**Exhaust Steam Heating Encyclopedia.**"

Canada Foundry Company, Limited

TORONTO, ONTARIO

Montreal	**Ottawa**	**Winnipeg**	**Vancouver**
Halifax	**Cobalt**	**Calgary**	**Nelson**

The advertiser would like to know where you saw his advertisement—tell him.



HORIZONTAL
RETURN TUBULAR BOILERS

BUILT FOR ANY PRESSURE DESIRED. BUILT TO PASS INSPECTION IN ANY PROVINCE. ARRANGED FOR ANY SETTING REQUIRED, WHETHER IT BE STANDARD, DUTCH OVEN, OR SPECIAL. BOILERS WILL BE BUILT TO REST ON BRICKWORK, OR FOR SUSPENSION FROM GIRDERS AND BEAMS.

THE BEST MATERIAL, MANIPULATED BY EXPERIENCED WORKMEN, ENSURE A FIRST CLASS BOILER.

We Employ Both. ***Consult Us.***

POLSON IRON WORKS, LIMITED

STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

TORONTO **CANADA**

REPRESENTATIVES IN CANADA FOR

The B. F. Sturtevant Co., Hyde Park, Mass., U S.A., Fans, Blowers, Heating and Ventilating

The John I. Thornycroft Co., London, England, Marine Motors

Figure the Saving!

Figure out for yourself how much you could **save**, in **coal**, if you were using the

Vulcan Soot Cleaner

Figure it on the following basis:

Cost of Coal

Average coal consumption by average water tube boiler per day..... 10 Tons
Three hundred working days per year..... 3,000 "
Cost of Coal at $3.00 per ton.....$9,000.00

Estimated Saving

By keeping the tubes absolutely clean with the Vulcan you save at least..... 5 per cent.
5% on $9,000 ..... $450.00

Cost of Vulcan

Average cost of Vulcan Soot Cleaner per water tube boiler..... $275.00

Returns on Investment

Average returns on the first cost of Vulcan, per year..... over 150 per cent.

Actual Saving

Evaporative tests with the VULCAN frequently show an increase in evaporation of 8 to 10 per cent.

The Vulcan for Fire Tube Boilers costs only $55. Guaranteed to pay for itself in six months.

In fact, the Vulcan Soot Cleaner produces more economy per dollar invested than any steam appliance connected with power plant practice. **That's why over 50 per cent. of the Vulcan business to-day is repeat orders.**

You know *your* plant—just figure what an annual five per cent. saving on *your* coal bill would amount to—then remember that the Vulcan is a guaranteed proposition—you risk nothing. Can you afford *not* to investigate? The facts are here—our booklet "Economical Steam Production" tells the whole story and gives much valuable data about soot and its removal.

A copy is yours for the coupon. Mail it now.

Vulcan Tube Cleaning Systems, Limited

Factory and Home Office:
4-11 Bonsecours St., -:- MONTREAL.

----------SIGN, TEAR OUT AND MAIL----------

Power House, Feb. 12, *Date*.....
Vulcan Tube Cleaning Systems, Limited,
4-11 Bonsecours St., Montreal.

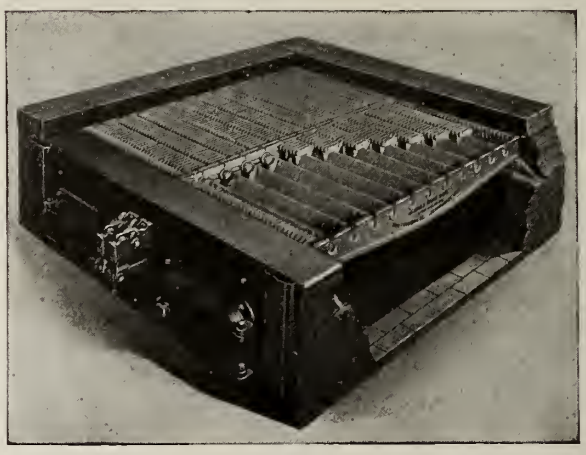
Please send us, without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.
(It is important that following information be given in full.)
Water Tube Boilers. Number.....Type..... Pressure.....
Horsepower.....No. Tubes High (except on Stirling boiler).....
Any Superheaters.....Width of alley space at side.....
Tubular Boilers. Number.....Horizontal or vertical.....
Name.....
Address.....

THINKS FOR THE FIREMAN

The Locking Device of the

MACDONALD SHAKING GRATE

operates independently of the fireman's memory.



The grates are locked in a horizontal position. The lever cannot be withdrawn if the points are in a position to be burned off.

The Macdonald grates cannot be moved until the shaking lever is inserted and locked in place. Unlocking the grates locks the lever.

You can change the grade of coal without altering the rocking or supporting bars — the removable tops can be furnished with any desired air spaces.

Ask for Bulletin No. 4.

Robb Engineering Co. Limited

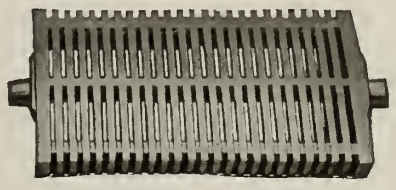
WORKS:
AMHERST, N.S., CANADA
SOUTH FRAMINGHAM, MASS., U.S.A.

DISTRICT OFFICES:
Canadian Express Bldg., Montreal, R. W. Robb, Manager
Traders Bank Bldg., Toronto, - William McKay, "
Union Bank Bldg., Winnipeg, - W. F. Porter, "
Grain Exchange Bldg., Calgary, - J. F. Porter, "

39-23

"THE Cyclone"

Shaking and Dumping Grate Bar



"The Grate Bar that is Imitated But Not Equalled"

This is the Grate Bar that has a record of long economical service. It is the "imitated kind" and only the best grade is imitated. However, the "Cyclone" leads them all in quality—it always wins out in the endurance test. Produces the same result from burning cheapest grades of fuel as that obtained by burning the best.

READ THAT LETTER

It is only one of the many testimonials that are constantly coming to hand.

Read it, because it is the evidence of the user. Why not profit by his experience and permit economy in your boiler room?

Write us for full details and prices.

Toronto, November 21st, 1911

Messrs. Canadian Steam Boiler Equipment Co., Ltd.
186 Queen Street East
City.

Gentlemen:—

In reply to your enquiry of the 21st, re the Cyclone Shaking and Dumping Grate Bar, we may say that we think we were the first people to use shaking and dumping grate bars on a brick kiln, viz., those you supplied us with four years ago. I have examined this grate bar and find that they are just as good as the day they were installed.

The last kiln you equipped with the improved Cyclone Grate Bar is giving excellent satisfaction and I think that the best testimonial that I can give is the fact that a few days ago I gave an order for another set of grates for my boiler, as I consider the installation of these grates will very soon pay for itself. They are saving probably 25% of my fuel bill.

Yours very truly,

(Signed) ISAAC PRICE.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST - - - - TORONTO, CANADA

AGENTS

ST. JOHN, N. B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.

The advertiser would like to know where you saw his advertisement—tell him.

The Murphy Automatic Smokeless Furnace

Commercially on the market 30 years. It is not an experiment.

See advertisement in the Power House, page 18, March 1912.

BELGO CANADIAN PULP & PAPER COMPANY, Shawinigan Falls, P.Q.
has had two winters' experience with MURPHY FURNACES and they write:

Dec. 4th, 1911

"Dear Sirs,

We have your letter of Nov. 28th enquiring as to conditions with us in which we presume you make special allusion to the Murphy Furnaces installed, and which we are pleased to state are working quite satisfactory. We are just now getting into the cold season and an opportunity to test the Murphy Furnaces under overload conditions will be offered for the next three months, but judging by the way these furnaces have behaved so far no trouble is anticipated for the period before us."

And under date March 16, 1912:

"Your letter of March 14th.
We have had, as you know, a very severe winter this year, and regarding your furnaces we are pleased to say that in spite of the low temperatures where the steam demand was excessively heavy, we have never lost a minute on account of steam, as the furnaces have stood up and done all that could be expected.

Yours truly,
THE BELGO CANADIAN PULP & PAPER CO."

Write for Catalogue and Information to

MURPHY IRON WORKS, DETROIT, MICH. BUFFALO, N. Y.

A busy paper mill in the United Kingdom, making cheap steam without smoke, smuts or grits by the use of "**Bennis**" machine stokers.

Cheap Steam for Industrial Undertakings

There are many PaperMills that are paying too much for their steam. With heavy fuel bills the boiler-duty is low and the boiler unable to respond rapidly to varying demands. Added to these troubles is that of a smoky and gritty chimney, the emission of smoke proclaiming imperfect combustion. "Bennis" Machine Stokers and Self-cleaning Furnaces reduce the coal bill, increase boiler-duty without detriment to the boiler, meet easily demands for rapid steam raising, maintain absolutely smokeless chimneys, and effect an all-round saving that makes their installation an investment.

A range of "**Bennis**" machine stokers increasing the steam output of water-tube boilers, and preserving boiler-life.

Write for "**Boiler-house Economy in Industrial Undertakings**" pamphlets to Ed. Bennis & Co., Ltd., Works: Little Hulton, Bolton, or to

GEO. H. TOD 213 Manning Chambers Queen Street West **TORONTO**

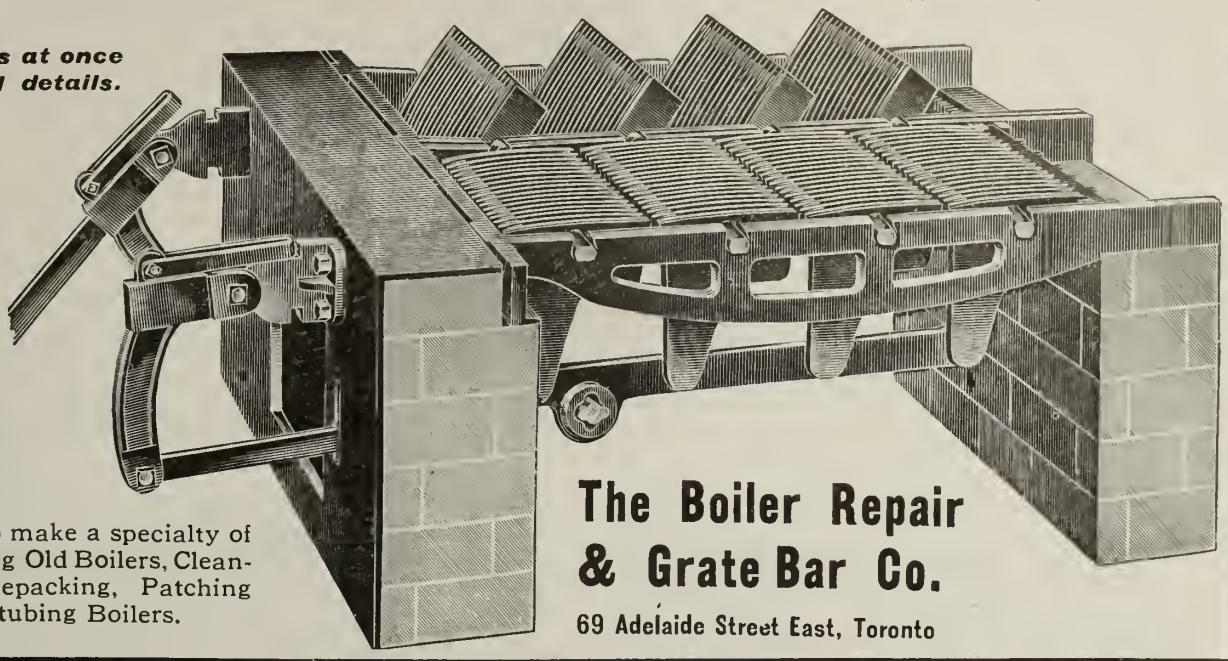
20TH CENTURY GRATE BAR

Is the Utmost Assurance of Fuel ECONOMY

The 20th Century Grate Bar is the result of years of experience. The grates are made of the best heat resisting metals and will not warp or burn out. This Grate Bar is so designed that it has more air space than any other grate, and greater dumping capacity for the removal of clinkers.

Install this Grate. We guarantee a saving in fuel from 10% to 25%.

Write us at once for full details.



We also make a specialty of Resetting Old Boilers, Cleaning, Repacking, Patching and Re-tubing Boilers.

The Boiler Repair & Grate Bar Co.

69 Adelaide Street East, Toronto

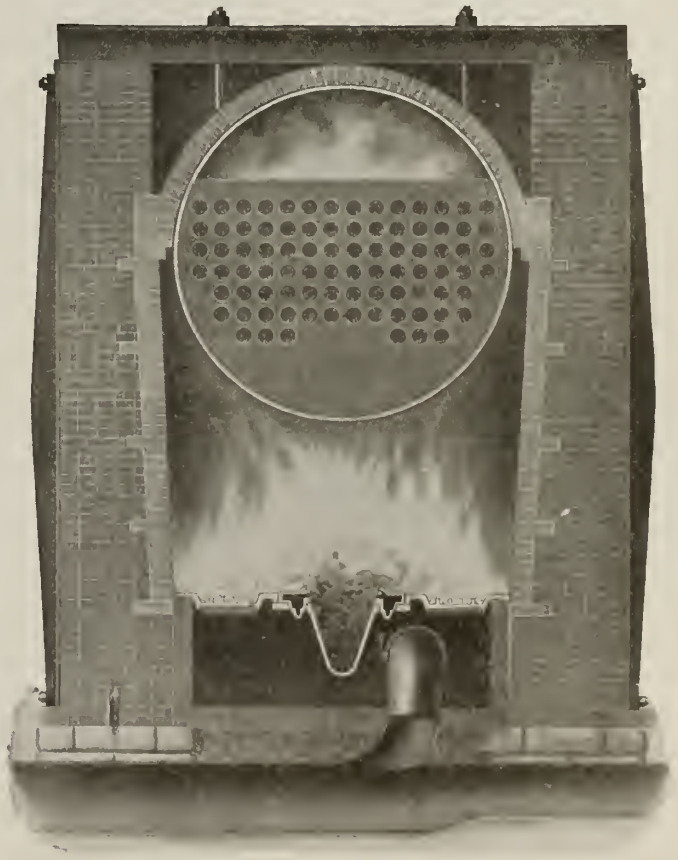
NO LOSSES

THERE are no grate bars in a Jones stoker, consequently NO LOSS of fuel through the bars.

The gases are driven off the coals and mixed with air ***beneath*** the fuel bed, pass through the fire, are brought up to the ignition temperature and consumed, consequently NO LOSS in unburned gases! NO SMOKE!

Utilizing the fuel with a minimum of loss, and with the automatic regulation of the steam pressure by the steam pressure itself, make a Jones Underfeed Stoker installation an ideal system of firing a steam boiler plant.

Let us tell you more about it.



Jones Underfeed Stoker Co., Limited

National Trust Building
TORONTO

Coristine Building
MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.

TRADE JENKINS MARK
Jenkins Bros.

TRADE JENKINS MARK
Jenkins Bros.

"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for ***genuine*** "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.

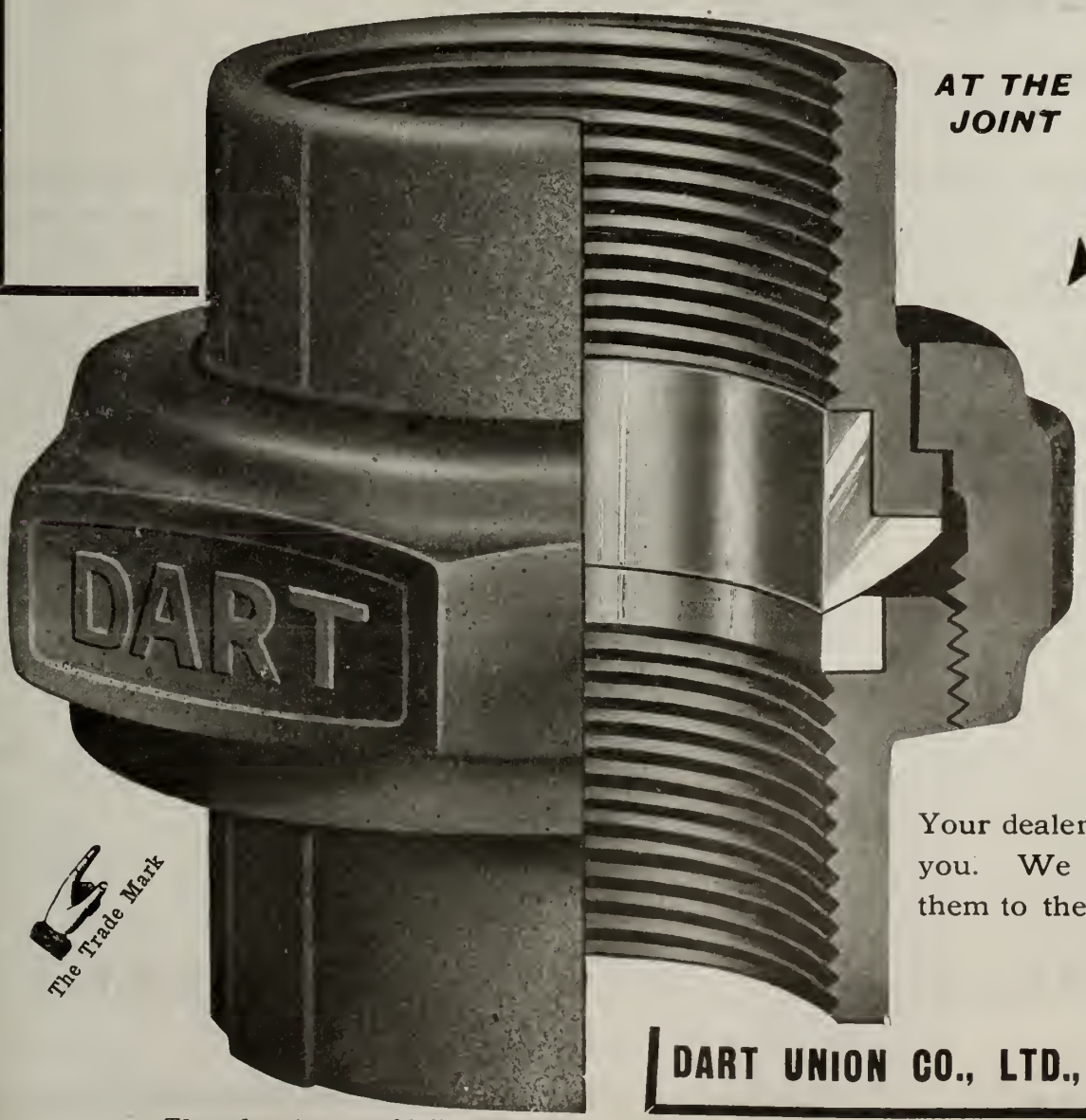
DART

There are no leaking union joints on the piping when Dart Unions are used.

This condition not only saves in the up-keep cost of the pipe, but it is a positive protection against damage being done finished product and equipment by drip from union leaks. You know damage caused by drips is often exceedingly costly.

Dart Unions never leak.

BRONZE to BRONZE AT THE JOINT



CANNOT RUST

CANNOT CORRODE

The Trade Mark

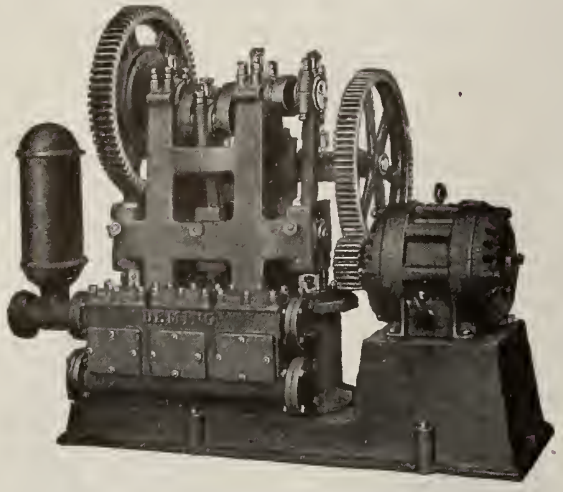
Your dealer can supply you. We guarantee them to the full extent.

DART UNION CO., LTD., TORONTO.

The advertiser would like to know where you saw his advertisement—tell him.

DEMING TRIPLEX PUMPS

Deliver an EVEN, STEADY STREAM



GENERAL SERVICE DEMING TRIPLEX POWER PUMP FOR OPERATION BY ELECTRIC MOTOR.
Made in all sizes.

One plunger is always on the downstroke.

This maintains an unwavering pressure.

Liquids flow from the discharge pipe in a steady stream, free from pulsations.

No jerky action to wear out the motor.

Made also for operation by belt and gas or gasoline engine.

Tell us under what conditions your pumps will have to work.

The Deming Company
Salem, Ohio :: U.S.A.

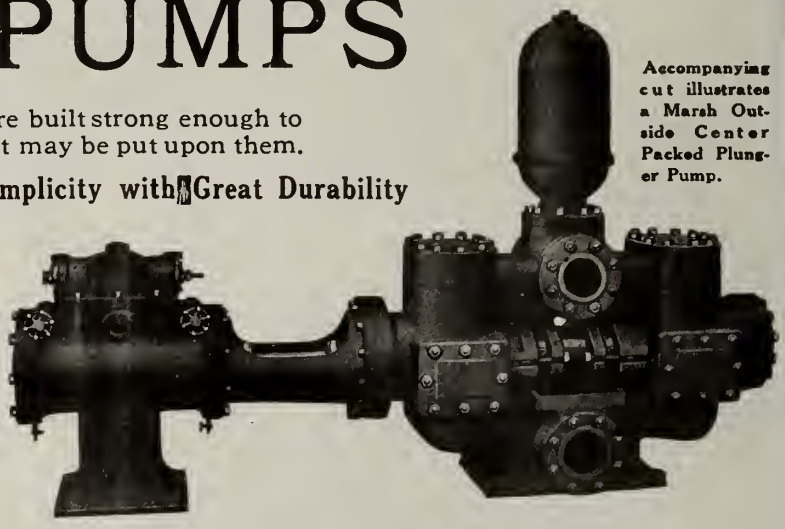
Hand and Power Pumps for all Uses.

GENERAL AGENTS :
DARLING BROS., 303 Owena St., MONTREAL

MARSH PUMPS

Are the heavy, massive kind, that are built strong enough to withstand any unforeseen strain that may be put upon them.

They Combine Efficiency and Extreme Simplicity with Great Durability



Accompanying cut illustrates a Marsh Outside Center Packed Plunger Pump.

TAKE the pump shown here, for instance, note the massive construction, note the absence of outside moving parts on the steam end and the general simplicity in construction throughout. The Marsh Pumps are not cheap in any sense of the word. They are built for long, continuous service and every pump is absolutely guaranteed for the service on which it is recommended. We stand back of all our material and workmanship for one year.

Our new No. 18 general catalog illustrates and describes the different types of Marsh and American Pumps. Write to-day for your copy. It is a treatise and reference book every engineer and power plant superintendent should possess. It is free on request.

CANADIAN AGENTS

A R. Williams Machinery Co., Toronto
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Hallman & Peniston Machinery Co., Vancouver, B.C
Mechanics' Supply Co , Quebec, Que.
Gorman, Clancey & Grindley, Limited.
Edmonton and Calgary.

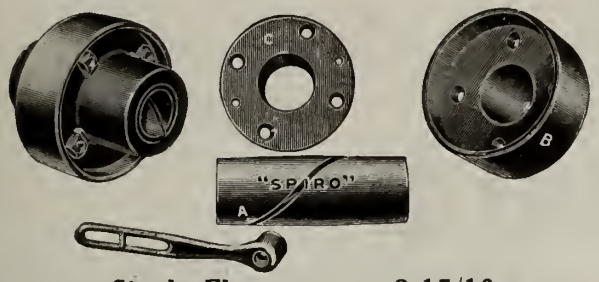
AMERICAN STEAM PUMP COMPANY

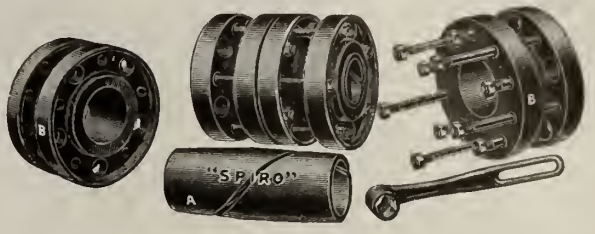
Battle Creek, Mich.

Make Your Assurance "Double Sure" and Grip Your Shafts With

THE BOND PATENT "SPIRO"

Compression Coupling





A—Sleeve. B—Shells.

Single Flange up to 2 15/16. Double Flange above 2 15/16.

50% more gripping power than any other coupling on the market.
Catalog "Y," showing complete line of power transmission appliances,

SENT ON REQUEST

CANADIAN BOND HANGER & COUPLING CO., LIMITED

MANUFACTURERS

ALEXANDRIA, ONTARIO

NUMIDIAN CYLINDER OIL
VELOX ENGINE OIL
EVERY GALLON GUARANTEED

"The choice of every engineer who knows."

Before buying your next supply of oil, write us and let us send you a sample of these high-grade oils. They are certain to give you better power transmission and add longer life to your machinery.

Send us your request to-day.

C. C. Snowdon

Wholesale

P.O. Box 1384. CALGARY, ALTA.

FLEXIBLE INTERLOCKING METAL HOSE

For Conveying Steam, Air, Gas, Etc.

This metal hose is made in either steel or copper and is just as light and flexible as rubber.

It will not kink, burn out or rot, and will give real service under all conditions.

Its lasting qualities are many times greater than those of rubber and there is practically no cost of maintenance.

Our prices are right. Get our circulars NOW.

The Metallschlauch-Syndikat

PFORZHEIM, BADEN - GERMANY

F. J. SCHUCH

191Jarvis St. - Toronto, Canada

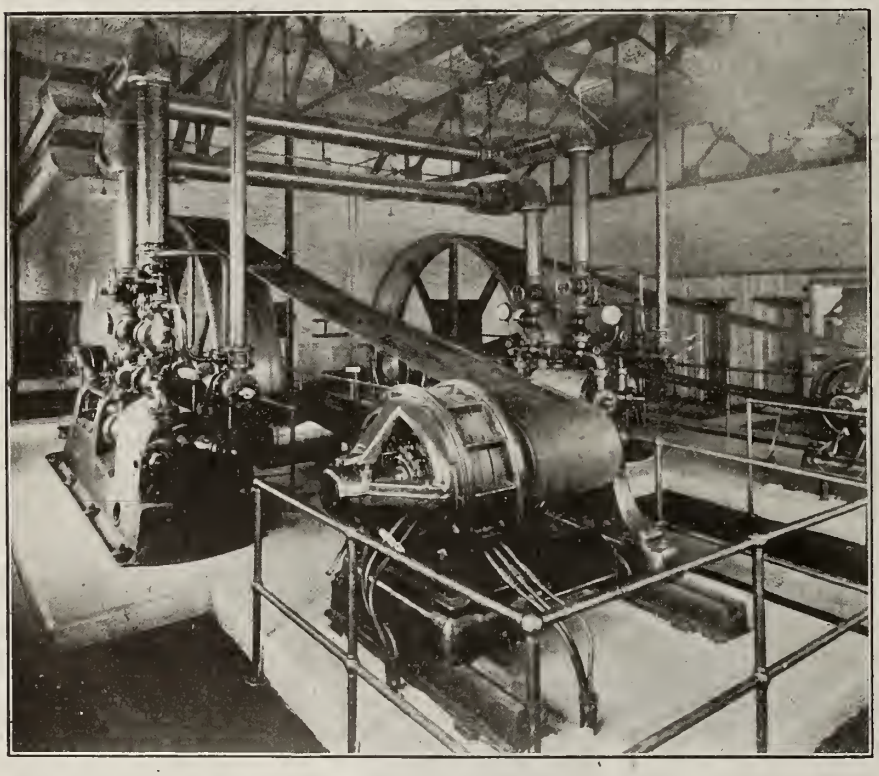
(Canadian Agent)

"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt Driven, Double Acting, Horizontal Ammonia Compressors Manufactured and Installed by us in Canada.

Recent Orders:—

BERLIN LION BREWERY, Berlin, Ont.
HUDSON BAY CO., Winnipeg, Man.
JOSEPH MOYNEUR, Ottawa, Ont.
C. P. R. ALGONQUIN HOTEL, St. Andrews, N.B.
MOIRS LIMITED, Halifax, N.S.
FRIZZELL'S MEAT MARKET, Prince Rupert, B.C.
NATIONAL DRUG CO., Montreal, P.Q.
CARSON'S HYGIENIC DAIRY, Winnipeg, Man.
HALIFAX BREWERIES. Halifax, N.S.
A. MACDONALD CO. Yorktown, Sask.
SWIFT CANADIAN CO., Fort William, Ont.
MOOSE JAW DAIRY, Moose Jaw, Sask.

AND MANY OTHERS.

The Linde Canadian Refrigeration Co., Limited

37 ST. PETER STREET, MONTREAL.

BRANCH OFFICES—Toronto, Imperial Building, Adelaide St.; Winnipeg, 110 James Street E.; Vancouver, Imperial Block, Seymour and Pender Streets; Edmonton, 562 Second Street.

The advertiser would like to know where you saw his advertisement—tell him.

THE LINDE BRITISH REFRIGERATION CO., LIMITED

ESTABLISHED 26 YEARS.

HEAD OFFICE, 35 Queen Victoria St., London, E.C.

DIRECTORS :

PROF. C. Von LINDE.
C. Von LANG PUCHOFF,
K. S. MURRAY,
R. C. GRANT,
G. H. LLOYD, Chairman,
T. B. LIGHTFOOT, Managing Director

TRADE **LINDE** MARK

BRANCHES:

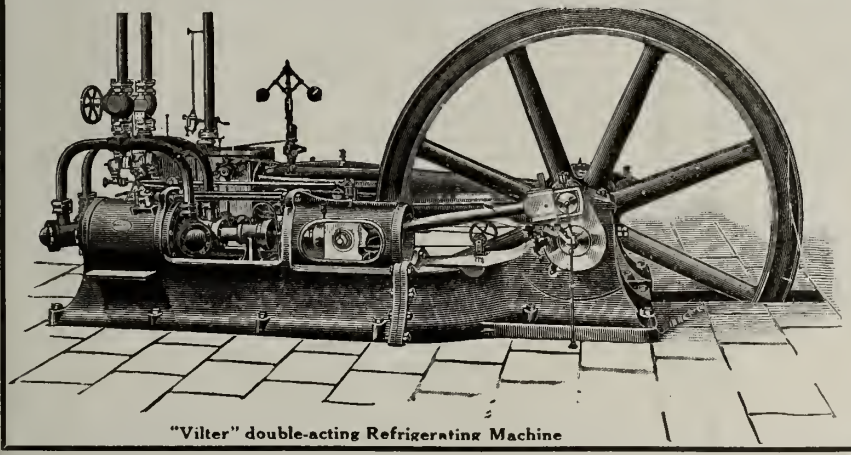
CALCUTTA
SYDNEY, N. S. W.
PORT NAPIER, N. Z.
JOHANNESBURG, S. A.
MONTREAL.

OVER **8000** MACHINES SOLD

for every purpose requiring

MECHANICAL REFRIGERATION

628-9 CORISTINE BUILDING, MONTREAL, P. Q.



"Vilter" double-acting Refrigerating Machine

Established 1867

The **VILTER MFG. CO.**

242 Becher St. Milwaukee, Wis.

BUILDERS OF HIGH-GRADE

CORLISS ENGINES
ICE AND REFRIGERATING MACHINERY

any size and for any purpose, complete line Ammonia Fittings, Condensers, Brine Coolers, etc.

Write for Catalogue and full Particulars

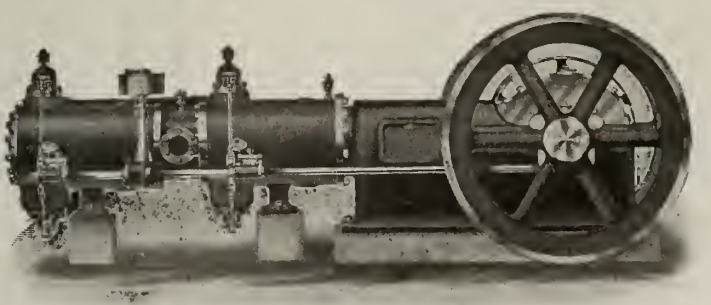
Type E.S.T.

-NOTICE THE CROSSHEAD--

Gas Engines for Perfect Regulation

Built like High Grade Steam Engines

Single and Double Tandem. A power impulse every stroke.

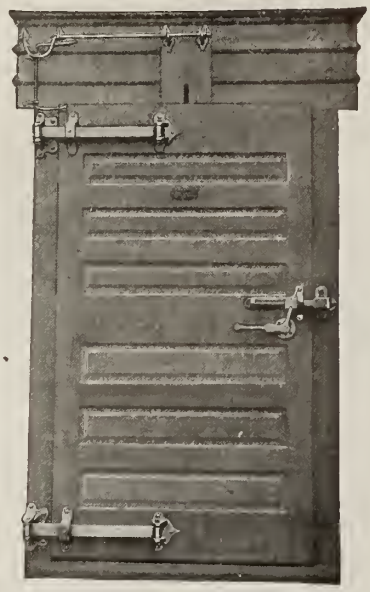


The GENERAL MACHINERY CO., Limited

526-7 Traders Bank Building, - - Toronto

The advertiser would like to know where you saw his advertisement—tell him.

J. V. Jamison, President. T. B. South, Vice-President. J. V. Jamison, Jr., Treasurer.



This "Ad" is addressed to users of

Refrigerator Doors, Windows and Ice Chutes

in Canada

for Cold Storage, Meat, Fish, Dairy, Poultry, Fruit and Vegetable products.

We guarantee our Doors not to sag or stick in the frames.

Our Hardware weighs 60 lbs. to set.

We manufacture or sell nothing else.

Our entire time and forces are directed to this line.

We supply

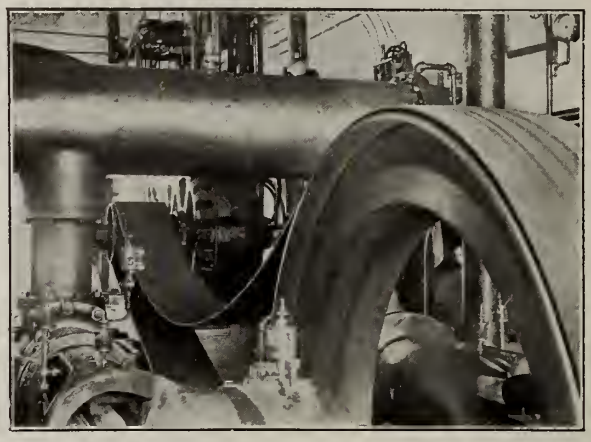
Linde British Refrigeration Co.
Linde Canadian Refrigeration Co. of Canada.
Armour & Co., Chicago, Ill., U.S.
Swift & Co., Chicago, Ill., U.S.

with all they use. Our latest orders are to Swift & Co., for Toronto, Can., 30 Doors; Canadian Fish and Cold Storage Co., Prince Rupert, B.C., 110 Doors.

Send for Catalogue

Jones Cold Store Door Co.

HAGERSTOWN, MARYLAND, U.S.A.



This installation in Dundas, Ontario, proves conclusively that slack belts treated with Cling-Surface pull intermittent loads easily.

Some people think that because of the slight velocity change in air compressor and gas engine fly wheels, and the intermittent loads on wood and metal planing machinery and the like, the belts on the drives must be run tight to prevent slipping or running off.

Without Cling-Surface such drives often do give trouble, but we have yet to find an instance where systematic Cling-Surface treatment and a slack or easy running belt, as made possible thereby, are not better for this service. The belt shown above, in the John Bertram & Sons' plant, which is also the Canadian plant of the Pratt & Whitney Co., Dundas, Ont., is a typical example. This is a 12 in. laminated driving a Rand air compressor with 5 ft. pulley from a motor with 14 in. pulley, on 13 ft. centers. The load varies from 25 to 82 h.p., and the belt speed is abont 2,500 ft. per min. Cling-Snrface has been used here since May, 1910, and the belt has given absolntely no trouble since. This belt now runs slack without slip, even nnder full load, and when photographed was carrying 75 h.p., the sag being 24 inches. With Cling-Surface treatment any similar belt may be rnn slack or easy much more economically than if run tight.

Cling-Surface does what nothing else will do in producing two chief basic results. Flrst, it preserves the belt, keeping it in best possible health and vigor, so that it can work and can last, and second, it then MAKES the belt work by eliminating the possibllity of slip under usual loads or reasonable overloads.

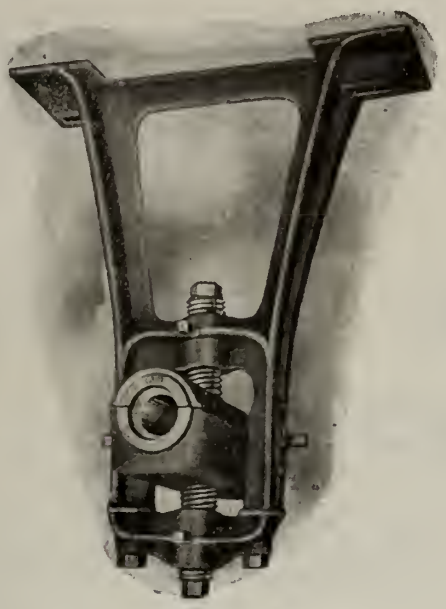
Thls accomplishes further economic results of great value in power transmission. Vlgorous, healthy belts are capable of close and lntimate pulley contact with accompanying minimum expense for upkeep and replacements. With slipping so eliminated, no initial tension is necessary. The belt can be run easy or slack, and the slacker it can be run the more pulley it wiil wrap and the more power the belt can transmit. Under snch conditions, high efficiency is only natural. The reduction in friction load means economy of babbitt, oil, fuel and power, with ease on belts, bearings, shafting and engine. Less time is lost through accidental stoppage, for belts that do not slip do not rnn off, and eased belts are not so apt to break or destroy iacing.

Regular and systematic Cling-Surface treatment is bound to produce important economic results. Cling-Surface IN YOUR BELTS wiil say much more for itself there than we can say here. Make the trial or ask for literatnre.

Cling-Surface Co

1057 Niagara Street Buffalo N Y

56



Elmira Hangers

Offer you the following advantages:

The Hanger is of good weight, ample strength, correct design and has the metal properly distributed.

Bearings are lined with a high-grade anti-frictional metal. There is nothing better than a good babbitted bearing. Don't be talked into anything else. The bearings are made with a large cast-iron oil reservoir and are equipped with a

Positive Oiling Device consisting of woven cotton wick and tempered steel rings. Your shaft has thus two ways of getting oil. This system of lubrication in connection with the Elmira Hanger has never been known to fail.

Adjustment. The hanger can be adjusted in every direction, and when the hangers are up your shaft can always be easily adjusted.

Your order can be filled from stock same day as order is received.

The Elmira Machinery & Transmission Co.
Limited
Elmira - Ontario

Stock carried in Montreal by
The A. M. ELLICOTT CO., 301 St. James Street

The Characteristic Feature of the

Coventry "Noiseless" Chain

is its simplicity of construction. A case-hardened steel bush forced into the laminated links gives the rivet a solid hard-to-hard bearing.

No multiplicity of parts to cause initial stretching of pitch until the rivet finds its proper bearing.

The rivet of the "Noiseless" link is down solidly in its seating right from the first revolution of the drive.

Therein you have the whole secret of the success of the COVENTRY "Noiseless" Chain Drives. They have stood up to the severest endurance tests to which driving chains have ever been subjected.

Small wonder then that the Coventry Chain Company has grown and enlarged with such phenomenal rapidity that even to-day, with the most modernly equipped chain factory in the world, and working night and day, they are scarcely able to supply the demands for COVENTRY Chains.

May we tell you something of the accomplishments of the Coventry Chains? Write the

Canadian Sales Agents:

John Millen & Sons, Ltd.
Montreal Toronto Winnipeg Vancouver

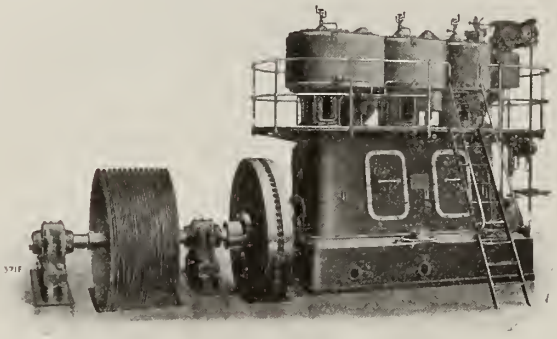
Address all correspondence to 321 St. James Street, Montreal

The advertiser would like to know where you saw his advertisement—tell him.

Good Transmission is Essential

BUT

EFFICIENT PRIME MOVERS ARE INDISPENSABLE



ENGINES

Our high speed vertical engines are well-known standard types.

Forced Lubrication.
Lowest Oil Consumption.
Guaranteed Steam Economy.
Noiseless running.
Simplest Compounds and Triples on the market.

BELLISS & MORCOM

TURBINES

Impulse type, **avoiding close clearances** over the vanes.
Drum construction, with consequent **rigidity.**
Through Shaft utilized to obtain **perfect alignment.**
Blades, each one **held** secure **independently from others.**
Lubrication and Governing, of **Belliss Standard** for their reciprocating engines.

SHALL WE SEND YOU OUR PAMPHLET?

Sole Canadian Agents:

LAURIE & LAMB

BOARD OF TRADE BUILDING, - - MONTREAL.

The Sun Never Sets on

IMPERIAL GAS, OIL AND GASOLINE ENGINES

I deal Engines
Magnificently Made
Perfect Workmanship
Excellent Value
Really Reliable
Increasingly Popular
Attractive Appearance
Liked by all.

Sole Selling Agents for Canada

H. W. PETRIE, Ltd.

MACHINERY EXPERTS

Toronto Montreal Vancouver

Who will be pleased to supply

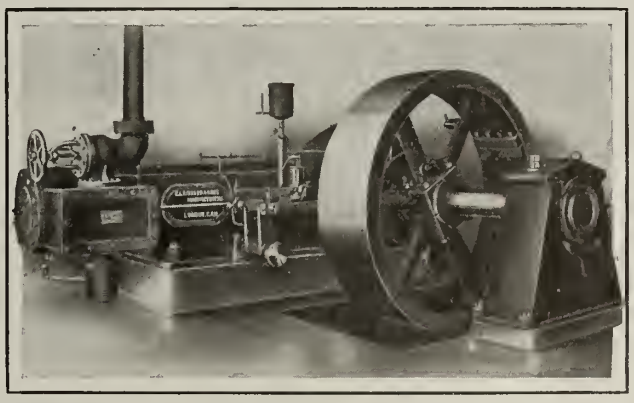
CATALOGUES AND FULL SPECIFICATIONS

Easily Managed
Neatly Finished
Governed Sensitively
Improved Lubrication
Newest Designs
Economically Worked
Satisfaction Assured

Invented and Manufactured by the

KEIGHLEY GAS & OIL ENGINE CO., Ltd.

KEIGHLEY, ENGLAND



Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY

E. LEONARD & SONS, LONDON, ONTARIO

MANUFACTURERS OF

High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants.

WAREHOUSES AND AGENCIES AT

MONTREAL, ST. JOHN, N. B., CALGARY, WINNIPEG, VANCOUVER

The advertiser would like to know where you saw his advertisement—tell him.

Why YOU Should

USE ELMIRA PULLEYS

Large stocks carried. Deliveries same day as order is received.

They will do what you want them to do, last a lifetime and never need renewing.

Belt Grip. The same belt with the same tension will deliver from 25% to 60% more power from **ELMIRA** Pulleys than with any cast-iron pulley made.

Compression Fastening Hubs are as wide as the face of the pulleys. Bushings made in two halves, more and heavier bolts used in the **ELMIRA** Pulley than in any other on the market.

Strength. The rim is wide and made of the highest grade of soft maple. The rim is built up, glued and **Nailed** throughout. The nails are used inside where you cannot see, as well as on the outside sections. The **ELMIRA** Pulley is nailed through and through.

Balance. Every pulley is perfectly balanced before leaving the works.

Manufactured by

Elmira Machinery and Transmission Co.,
LIMITED
ELMIRA - - ONTARIO

Stock carried in Montreal by THE A. M. ELLICOTT CO., 301 St. James Street.

LOOKING FOR THE "MAPLE LEAF"

is increasingly a habit with those who buy much Belting.

The reason is not hard to find, for there is no part of your Belting system, from the main drive to the smallest light Belt for power transmission, where you will not get the best kinds of service from

"MAPLE LEAF" BRAND
Stitched Cotton Duck Belting

It is the most economical Belting because it is durable under every condition; even where other Belting will deteriorate rapidly. It is water proof.

It runs absolutely true on the Pulleys.
It is built of plies of selected duck.

WRITE FOR INFORMATION AND PRICES

DOMINION BELTING CO., Ltd.
HAMILTON, CANADA

The advertiser would like to know where you saw his advertisement—tell him.

SHAFTING BEARINGS

Countless thousands of dollars have been wasted in power, oil, metal, labor, etc., in a mistaken idea of economy by using cheap or inferior metals on shafting bearings. The following letters show the value of Magnolia Metal for that service:—

THE CITIZENS' ELECTRIC CO., LTD.,

Smith's Falls, Ont., Jan. 28th, 1911.

Gentlemen:—

Yours of the 27th inst. to hand and noted. Regarding the boxes you mentioned, lined with "MAGNOLIA METAL," would say we have 60 ft. 3½-in. shaft, running 300 rev. per min., running all night and every night in the year, put up over 10 years ago, and still running perfectly, and has never been touched in that time except for oil, and one tablespoonful will run each box for 12 hours.

Yours very truly,

J. A. SCROGGIE,
Eng. and Electrician.

KAUKAUNA GAS, ELECTRIC LIGHT & POWER CO.,

Kaukauna, Wis., June 15th, 1911.

Gentlemen:—

I have used "Magnolia Metal" for the past six years. I placed some of this metal in chain oiling boxes on a 4 7-16 in. line shaft running 278 R.P.M. in October, 1905. This shaft has been running continuously 24 hours a day ever since.

I have not found it necessary to rebabbitt any of these boxes to date, nor have I had any burn-outs.

I am also using Magnolia Metal for belt-driven dynamos, ranging in speed from 900 to 1,275 R.P.M., and have found the metal much more satisfactory than any other I have used.

Yours truly,

N. B. MONTGOMERY,
Chief Engineer.

Paterson, N.J., Sept. 21st, 1911.

Gentlemen:—

It is with great pleasure, that I comply with your request, voicing my opinion of your Magnolia Metal.

My opinion is based on many years' experience, having used it all over for lining-bearings on generators, motors, engines, shaftings, looms, etc.—am using it now on our motor trucks without having any trouble whatever.

I would not under any circumstances use any other metal or substitute for it.

I am most sincerely yours,

MAX STECHER,
Ch. Eng., Julius Brandes Mfg. Co.

SPECIAL OFFER.

PRACTICAL ENGINEER POCKET BOOK: 700 pages, over 2000 subjects. Price 40c. postpaid. We do not aim to make a profit on these books. We buy them in large quantities as an advertising medium and give Engineers the benefit of low price. They are highly spoken of by Engineers. **Address Montreal Office.**

Sold by leading dealers everywhere or by

Magnolia Metal Co.

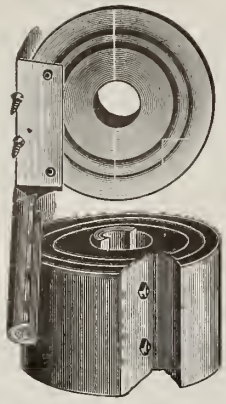
225 St. Ambroise Street, Montreal

New York Chicago

LIMESTONE PULLEYS

ENSURE

ECONOMICAL RESULTS

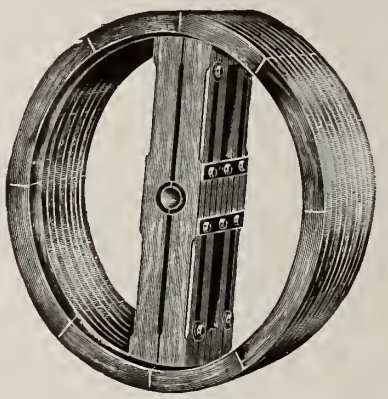


"Limestone" Solid Pulley

THIS high-grade Pulley is the result of over twenty-two years' experience.

We believe we have in the **"LIMESTONE"** the strongest, best made, and best finished Wood Pulley on the market.

Since we first started manufacturing Pulleys we have made many changes, but always with the aim of bettering this product, so as to retain the lead and give the trade the best value for their money.



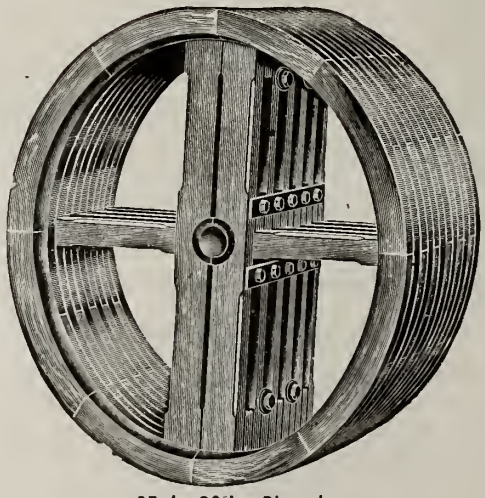
11 to 36 in. Diameter

Every step in the construction of the **"LIMESTONE"** is under the supervision of experts, and the materials used are the very best that are obtainable.

The rims are made of sections nailed and glued. Arms are white oak. The spokes are tenoned into the rim and there secured in such a manner that the strain of compression is equalized upon an extended portion of the rim.

GUARANTEE.—We absolutely guarantee every Limestone Pulley to give satisfaction in every respect, and to be in every way as represented. Should one of them fail in this, it may be returned at our expense, and money will be refunded or a new pulley given instead.

Write for our circulars and full details at once. It will pay you.

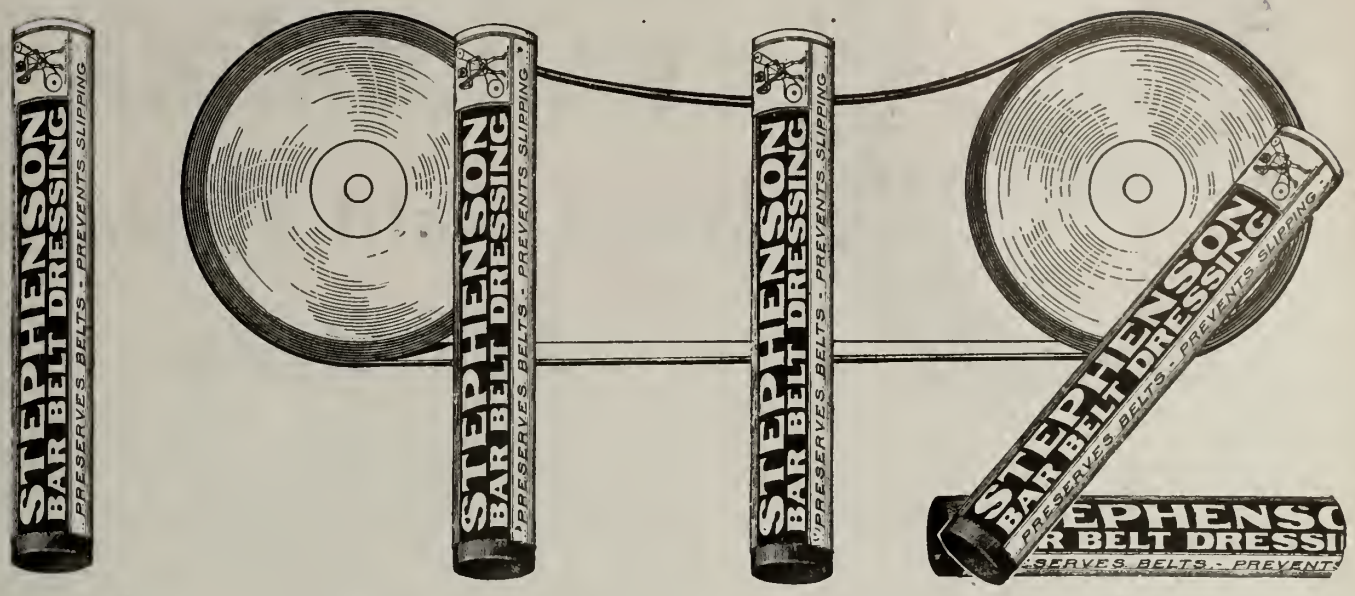


37 to 8[illegible]n. Diameter

The Crescent Oil Co.,

HAMILTON and TORONTO, ONT.

For



Use Stephenson Bar Belt Dressing

Make 1912 a record-breaking year. Turn over a new leaf and get rid of the things that have been causing needless trouble and expense. Adopt the things which will make your work easier, give better results and save money for your employer. You cannot start at a better place than with your belt dressing.

Get rid of those troublesome liquid dressings. Shake the can for the Stephenson solid stick and shake trouble at the same time.

Stephenson Bar Belt Dressing is a friend in need. It doesn't require preparation, nor do you have to use especial care in applying it. The minute the belt slips you hold the Stephenson bar to the belt for a few seconds and the slipping stops. There's no waste—no slop—no smearing on of paste or pouring on of spattering liquid. And the results are better.

I'll **"Stick to the Solid Stick."**

Start With A Free ½ Lb. Sample

Simply send us your name and address and we'll send you a present in the shape of a free half-pound sample of Stephenson Bar Belt Dressing.

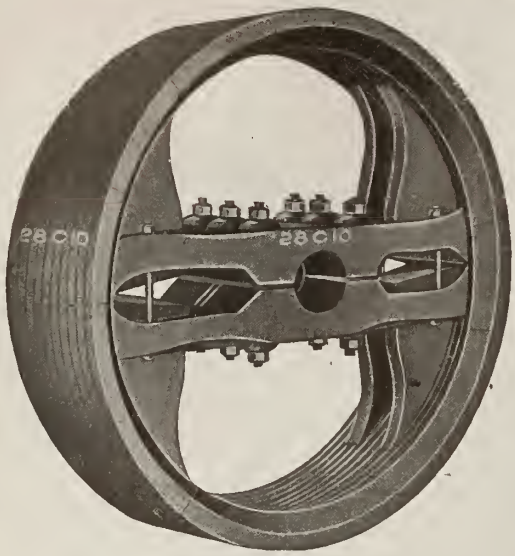
Remember—we give you this sample absolutely free of charge. Get this free half-pound of the finest belt dressing made and test it. Here's your chance to try something really good at no expense.

None Genuine Without Trade-Mark

Stephenson Manufacturing Company

Est. 1888 Albany, N.Y. Inc. 1897

The advertiser would like to know where you saw his advertisement—tell him.



How the Famous "FAIRBANKS" Wood Split Pulleys Are Made

THESE PULLEYS are the result of years of experience in the manufacture of Wood Pulleys. They embody several excellent features and are conceded to be, in every mechanical detail, the most perfect Wood Pulley made.

To insure all material being thoroughly dried, it is passed through two kiln drying processes.

The arms are made of birch in varying numbers of sections according to the width of the pulley, and are clamped to the shaft by through bolts.

A special feature of construction which makes these pulleys the peer of all others and overcomes the inherent objection to Wood Pulleys, i e., the separating of the rim from the arms, is the web. This web is mortised into the arms and rim, securely holding the whole pulley together.

The Rims and also the Webs are made of thoroughly seasoned bass wood, as it will transmit 25 to 60 per cent. more power than any other. The Rim is built up in segments or "lags" about 6 inches long. Every layer breaks joints with the preceding layer and each segment is nailed to the other by triple coated nails. These nails are triple coated to prevent them from pulling out and as a protection against dampness, oil, etc.

Each pulley is covered with several coats of special water-proof varnish, which forms an excellent surface for the belt.

The two centre parts are clamped together with square shank bolts. The third part is held in place by slot head bolts and forms a cover for the nuts of the main bolts.

These pulleys are bored to a standard and have a complete system of interchangeable Wood Bushings, one set of bushings furnished with each pulley.

The Canadian Fairbanks-Morse Co., Limited

Montreal St. John Ottawa Toronto Winnipeg Calgary Saskatoon Vancouver Victoria

Ten Big Reasons for Buying Dick's Balata Belting

1. Because it is the highest priced belt on the market. Could we get the highest price if it had not proven to be the best?
2. It has been on the market 25 years, which is ample time to demonstrate its worth.
3. It is used all round the world—in America, Europe, Africa, China and Japan.
4. They have been applied with the usual success to every variety of work for which belts are used, such as electric lighting, grain, saw and paper mills, oil, dye, print, brick, cement and engineering works, portable engines, threshing machines and mortar mills.
5. Great strength and durability.
6. Complete immunity to water, steam and changes of temperature.
7. Entire absence of stretching or slipping.
8. Strong gripping power, ensuring the transmission, positively without loss, of the whole power given off by the engine.
9. Perfect uniformity throughout and absolutely no fraying at the edges.
10. Because it is the **cheapest** when you consider the length of service.

We are exclusive Canadian Agents for Dick's Balata Belting and will send you a booklet for the asking.

The Canadian Fairbanks-Morse Co., Limited

Montreal St. John Ottawa Toronto Winnipeg Calgary Saskatoon Vancouver Victoria

The advertiser would like to know where you saw his advertisement—tell him.

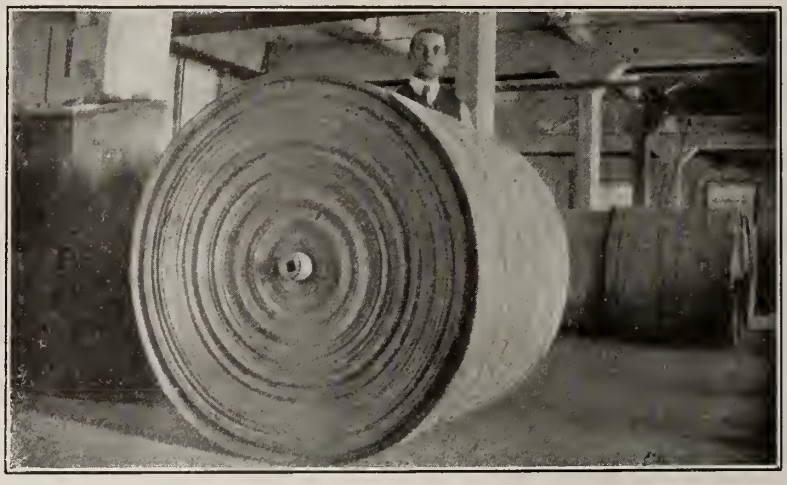
"DUNLOP"

TRANSMISSION BELTING

Besides minimizing your up-keep expense, this belting will transmit with certainty all the power that your engine can develop. Buyers of Dunlop Belting are backed by our "Two Hands" trade mark—a mark that has always been the emblem of good service and economy in rubber belting.

Let "Dunlop" Belting transmit your power— it does it "RIGHT."

Stands up under any test—no matter how irregular and severe. No separation of plies, nor rotting of duck from dampness and abnormal stretching—just service at its best.



DUNLOP CONVEYOR BELTING

Vertical suspension of Conveyor Belting, as in the case of mines and quarries, calls for emphasis on strength and uniform quality. We use a tightly woven duck in our Conveyor Belting, and a Rubber Friction of great holding power, which unites the different plies. That's why Dunlop Belting doesn't deteriorate.

We manufacture Belts for Saw Mills, Woodworking Plants, Quarries and Mines, and Conveyor Belting for any requirement.

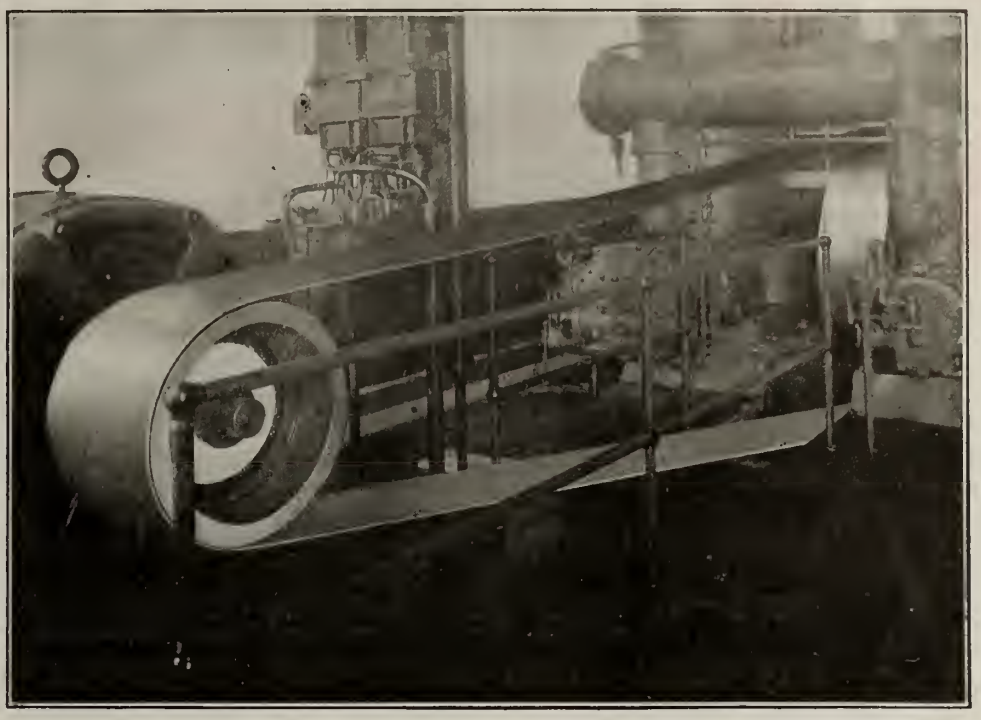
OUR GUARANTEE OF QUALITY

Dunlop Tire & Rubber Goods Co., Limited

Head Office and Works: TORONTO

Branches: Victoria, B.C. Vancouver. Nelson. Edmonton. Calgary, Regina. Winnipeg. London, Ont. Hamilton. Toronto. Cobalt. Ottawa. Montreal. St. John, N B.

Scandinavia Belting



Scandinavia Belting

is a good belt for transmission work, because it is woven of best long fibre cotton, and is woven solid; there are no plies to come apart.

After weaving it is treated with a water-resisting compound, which stays soft. It is then stretched and pressed between heavy rollers. By this means a belt is produced extremely strong and durable, and has lasting powers that are approached probably by no other belt.

Scandinavia Conveyor Belting

For conveying sharp rock and ore, we recommend our SCANDINAVIA MCM belt, but for such materials as sand, coal, wood, etc., we recommend our Scandinavia Special Conveyor belting, which is much cheaper, and its wearing qualities for such service are remarkable.

We will gladly furnish more information, if you will write, giving particulars.

Federal Engineering & Supplies, Limited

Head Office
284 Yonge St., Toronto

Branch Office
329 St. James Street Montreal

The advertiser would like to know where you saw his advertisement—tell him.

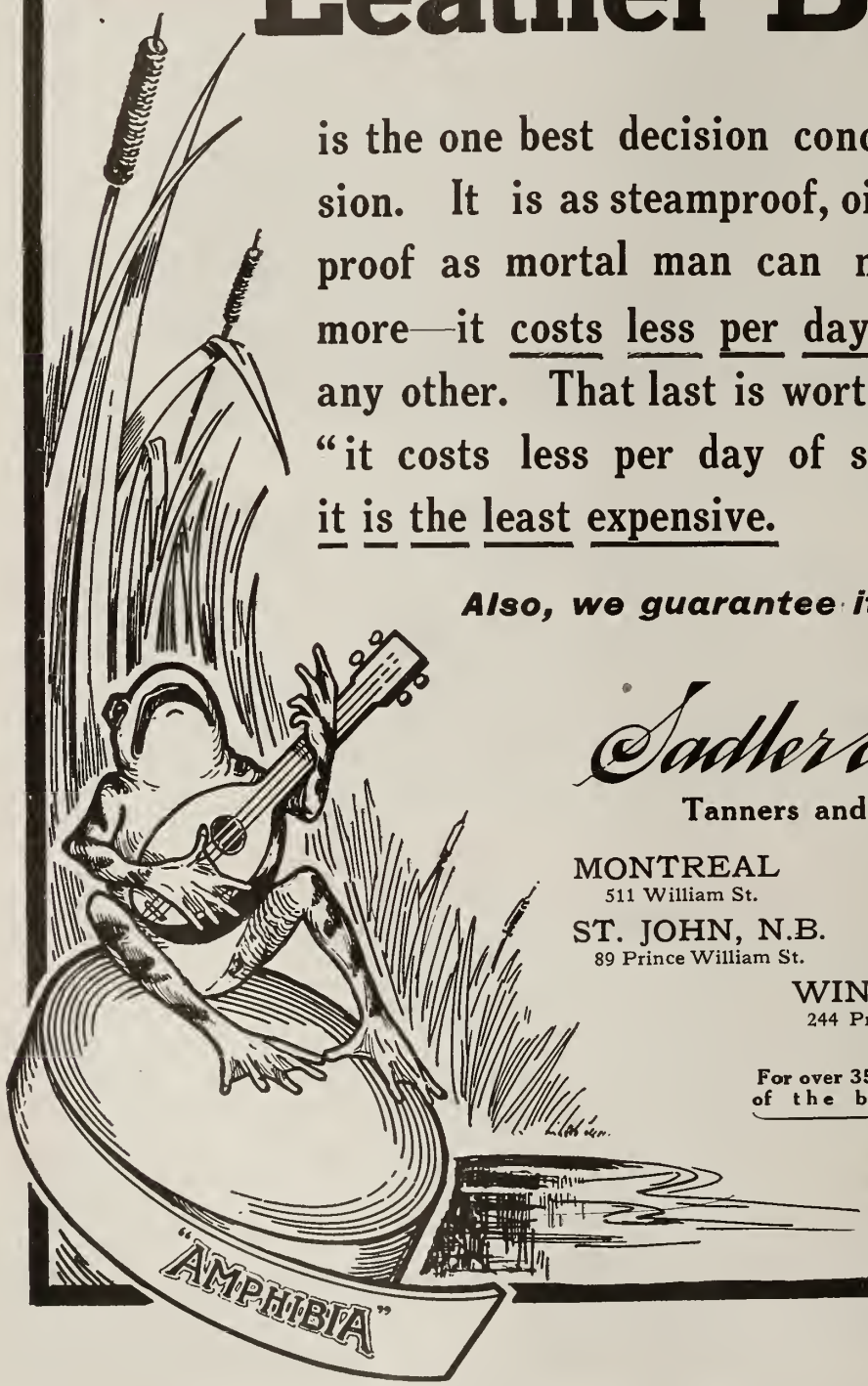
"AMPHIBIA"

(WATERPROOF)

Leather Belting

is the one best decision concerning transmission. It is as steamproof, oilproof and waterproof as mortal man can make it. What's more—it costs less per day of service than any other. That last is worth remembering—"it costs less per day of service," therefore it is the least expensive.

Also, we guarantee it absolutely.



Sadler & Haworth

Tanners and Manufacturers

MONTREAL
511 William St.

TORONTO
27 Melinda St.

ST. JOHN, N.B.
89 Prince William St.

VANCOVER
27 Columbia Ave.

WINNIPEG
244 Princess St.

For over 35 years the makers of the best leather belts

This makes a big difference to you.

The advertiser would like to know where you saw his advertisement—tell him.

LINCONA

BALATA BELTING

HAS A HIGH QUALITY

That Ensures a Saving

OF MONEY, TIME AND TROUBLE

MANUFACTURED BY
James Dawson & Son, Ltd., Lincoln, Eng.

"Lincona" stands pre-eminent as a transmitter of power. Is universally efficient under all normal conditions, especially in moist or damp places. The Quality cannot be surpassed. Absolutely best material used and workmanship guaranteed. Half a century's belt making experience behind our belt.

General Representative, D. W. CLARK, Montreal.

"LINCONA" is a Belting that retains the highest point in Belting economy and efficiency.

"LINCONA" Balata Belting is a product upon which every engineer can rely to produce better results and better value for his money.

With "LINCONA" the lowest cost of maintenance is easily attained, combined with perfect transmission of power.

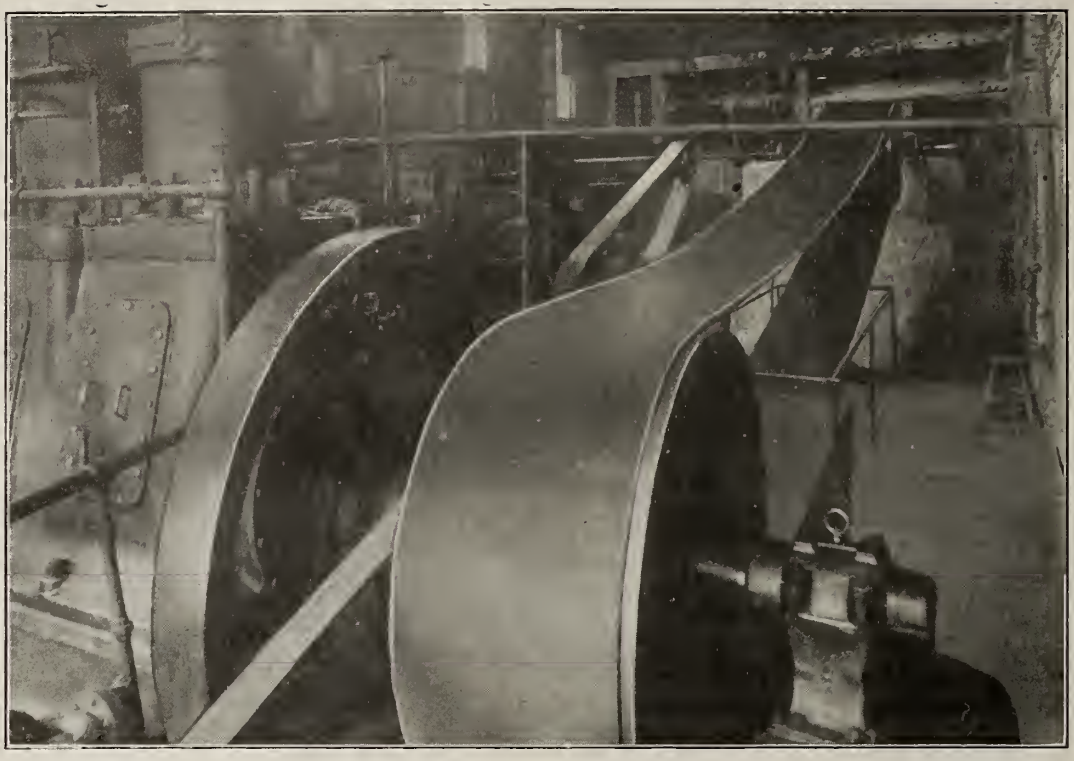
"LINCONA" is used all over civilization.

LARGE STOCKS HELD WITH

The Can. B. K. Morton Co., Ltd., Montreal.
Baines & Peckover, Toronto.
Austen Bros., Limited, Halifax.
Western Oil & Supply Co., Vancouver.
Bishop Sons & Co., Ltd, St. John's, Nfld.

HIGH QUALITY BELTING

Main Drives a Specialty



A RECENT PHOTOGRAPH OF 76′ x 32″ x 8-ply LEVIATHAN
Installed June 1st, 1906. 250 H.P. Drexel Engine.

As the title of our company indicates, we make a specialty of belts for main driving purposes; for the reason that we know Leviathan to be especially adapted for this character of service, it being stronger, heavier and more durable than the best leather. There are no joints in it to separate or peel, and its traction power is in excess of that of the best oak-tanned leather. We stand back of every belt turned out, therefore only ask your orders with the understanding that they do what we claim or your money refunded.

CUT THIS OUT

Main Belting Company of Canada, Limited

41 Common Street, MONTREAL

20 Wellington St. West, TORONTO

WE REQUIRE A BELT FOR TRANSMISSION

and will wish delivery about.....
Size of belt.....′ long by.....″ wide.
Dia. Driving Pulley.....
Dia. Driven Pulley.....
Approximate H.P.....
Revolutions of Driving Pulley.....

If the belt is used crossed, at quarter turn, with idler, or subject to any unusual conditions, including extreme heat, moisture, gas or oil, we state below.

....

Name.....
Address.....

The advertiser would like to know where you saw his advertisement—tell him.

VI-BALATA

Waterproof BELTING

A Greatly Improved Form of Balata Belting

Has Great Strength and Durability

Every Belt Guaranteed

This is a belting with which every engineer should get acquainted—a belting that is imitated but not equalled in quality.

We have added the Prefix "Vi" to our Balata Belting in order that our customers will not be deceived by inferior brands.

"VI-BALATA" Belting is absolutely waterproof and practically stretchless, and backed by our reputation and guarantee.

"VI-BALATA" Belting is a short way to a long, economical belting service.

Write us for testimonials and full details.

Let us send you one on trial.

The General Supply Co. of Canada, Limited

TORONTO

115-125 Adelaide Street West

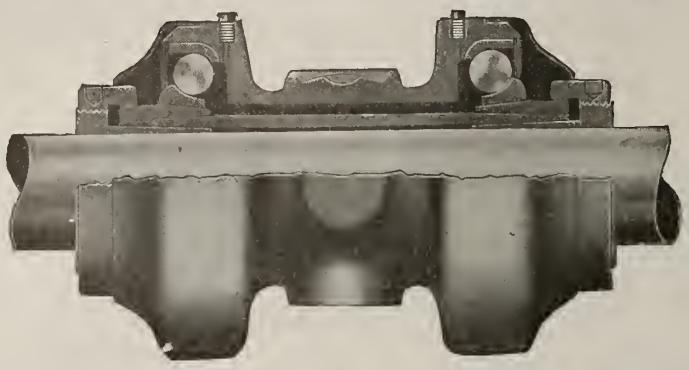
OTTAWA WINNIPEG

REDUCE YOUR POWER BILLS

from 15% to 35% by equipping your shafting with

CHAPMAN DOUBLE BALL BEARINGS

Fit Standard Hangers for all sizes of shafting from 1 inch to 6 inch. Save oil and attention.



In use over 8 years. Installed in over 1,000 of the leading Canadian Factories.

Write us for copy of our booklet "RESULTS," showing savings effected in other Factories, and give our Engineering Department a chance to show you what saving can be made in your plant.

The Chapman Double Ball Bearing Company of Canada, Ltd.

339-351 SORAUREN AVENUE, TORONTO, CANADA

PHONE PARK 2790

Not an Enterprise for the "Quitter"

¶ "If there is one enterprise on earth," says John Wanamaker, "that a 'quitter' should leave severely alone, it is advertising. To make a success of advertising one must be prepared to stick like a barnacle on a boat's bottom.

¶ "He must know before he begins it that he must spend money—lots of it.

¶ "Somebody must tell him that he cannot hope to reap results commensurate with his expenditure early in the game.

¶ "Advertising does not jerk; it pulls. It begins very gently at first, but the pull is steady. It increases day by day and year by year, until it exerts an irresistible power."

HANS RENOLD Patent Liner SILENT CHAIN

Superiority

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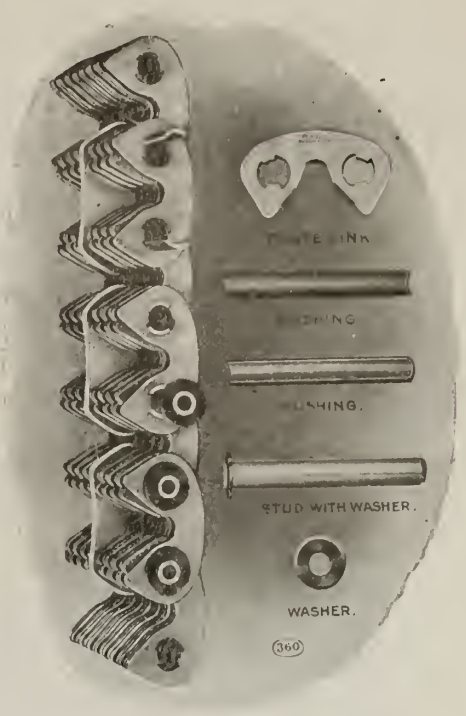

(Showing the Patent Bearings on the Renold Liner Chain.)

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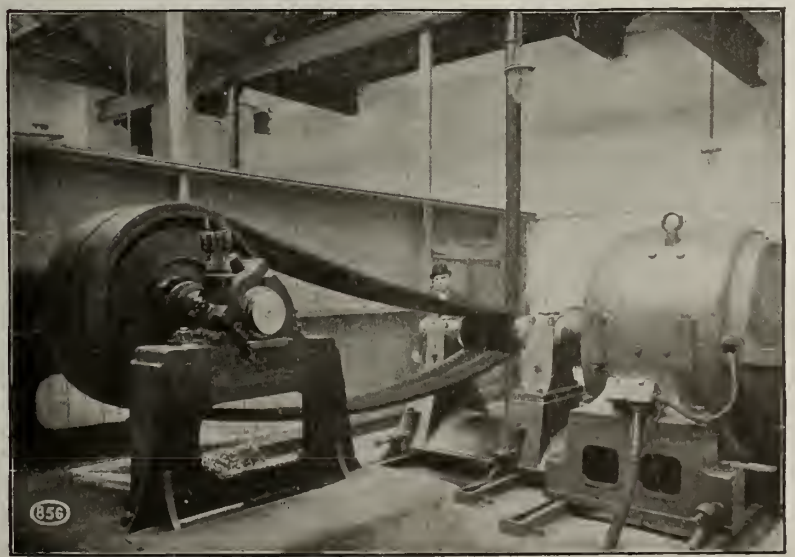

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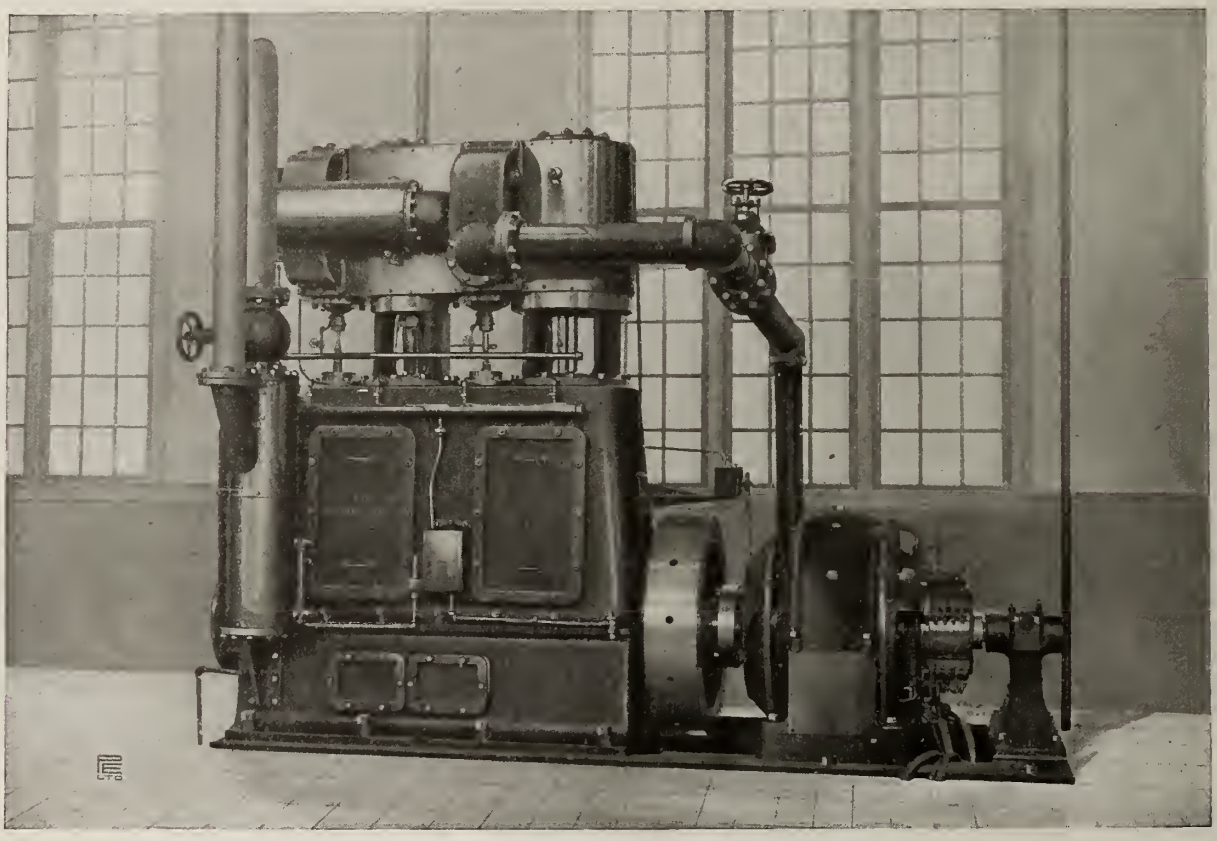

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The advertiser would like to know where you saw his advertisement—tell him.

Hydro-Electric Plant of the Kaministiquia Power Co., Ltd.

By J. H. Williams

A description of a plant owned and operated by a public utility company, which prides itself on the thoroughness and efficiency of the precautions taken to avoid failures. An entirely satisfactory and uninterrupted service is given its customers, both in winter and summer. The means taken to avoid trouble from ice at the intake are both interesting and instructive.

THE Kaministiquia Power Company, Ltd., is a private concern incorporated in 1905 under the Companies Act of Canada for the purpose of generating and supplying light, heat and power to the district of Thunder Bay, Ontario, including the two principal cities of Fort William and Port Arthur. The head office is located in the former city, while the executive offices are in Montreal.

The company commenced giving service in December, 1906, the load steadily increasing with the development of the two cities until it recently became necessary to enlarge the capacity of the plant very considerably in order to cope with the demand. Being confident that the rapid rise in land values and the general development of the district was no mere boom—but was a foretaste of even greater things to come—the directors decided to enlarge their power house, hyraulic works, etc., with a view to an ultimate service of from 35,000 H.P. to 50,000 H.P., the original maximum output having been 14,000 H.P. The enlargement of the plant was completed at the end of last year; the additional equipment bringing the capacity up to a maximum of 21,000 H.P.

The Kakabeka Falls.

The generating station is situated at the Kakabeka Falls on the Kaministiquia River, some 18 miles above Fort William. These falls are perhaps the most picturesque to be found west of Niagara, and lovers of Nature will be glad to know that their natural beauty has been in no way impaired by the company's works, since the power house lies some distance below them, while the intake is about a mile up-stream. For several miles above the falls the river, which is about 400 feet in width, flows between thickly wooded rocky banks, and passes over several rapids before taking its final sheer plunge of 110 feet to the gorge below. The falls present a scene of impressive grandeur and are visited by large numbers of tourists in summer.

KAKABEKA FALLS ON THE KAMINISTIQUIA RIVER

Students of philology may be interested to know that the word "Kakabeka" is Ojibway for "Laughing Waters," while "Kaministiquia" means "The River with Many Mouths," and refers to the delta at Fort William by which the river empties itself into Thunder Bay, on Lake Superior. Needless to say, the name generally proves too much of a mouthful for busy men, and the river is usually referred to locally as "The Kam."

Forebay, Penstocks and Power House. Falls in the middle distance. A third penstock has recently been added.

Intake and Hydraulic Works.

The intake works consist of two series of concrete dams and bridges, which control and regulate the entire flow of the Kaministiquia River, and also form a dead water service reservoir of ample capacity for all present and future requirements. At the main dam there are the necessary protecting booms, trash racks and submerged swivel gates for the complete control of all water passing to the power house. At the intake, back of the main dam, overflow and underflow sluices are fitted for carrying off floating and water-logged material or silt. These sluices also serve to control the elevation of the water to the forebay. The intake house proper is situated about 150 feet below the main intake. Here, an attendant is on duty at all times. He lives in the immediate vicinity and can communicate with the power house by signal and telephone. His duties are to regulate the intake levels in order to meet the changing load conditions, and to act as inspector of the company's hydraulic works, with special reference to the care and protection of drains and air vents. In this intake house further defence against obstructions is provided by close meshed removable racks, which in winter are kept above the freezing point by electric heaters, as will be explained further on in this paper.

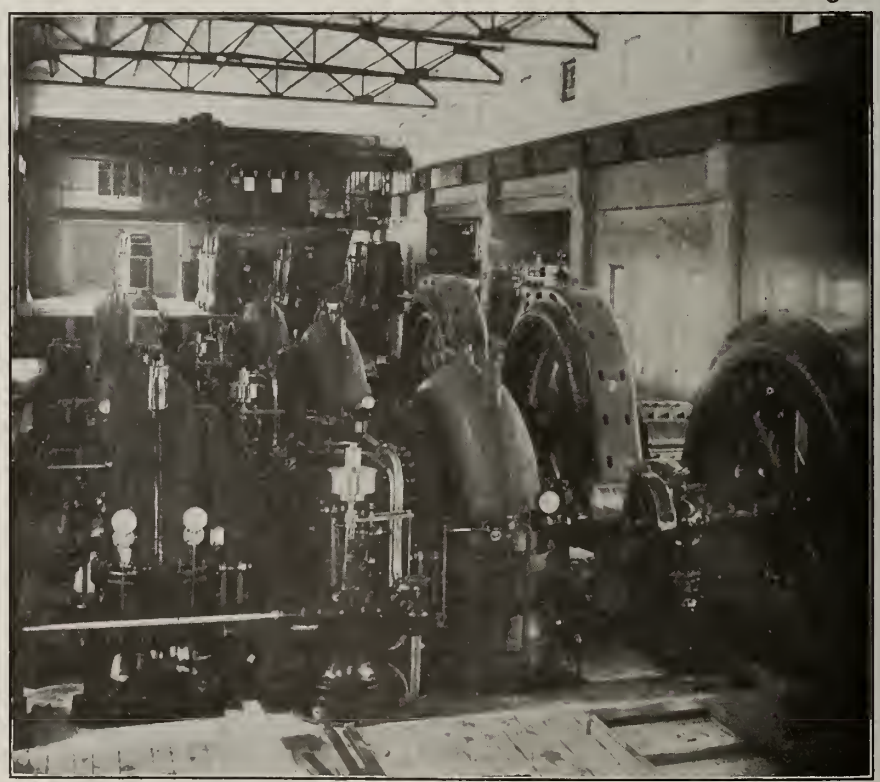
From the intake house the water is taken underground by two reinforced concrete aqueducts to the forebay. These aqueducts are 10 feet 5 inches inside diameter and are 6,500 feet long. To avoid trouble from frost they are buried underground and are fitted with drain pipes at all low points and 30-inch air vents at all high points. The aqueducts vary in elevation, according to the contour of the ground, being from 881 feet to 890 feet above sea level, measured to the base of the pipe. The circular reinforcing is of 5-8 inch square steel placed at from 7 to 10 inches according to the elevation of the aqueduct, while the location of the longitudinal rods is shown in the cut.

The operating conditions call for a normal elevation of 908 feet above sea level at the intake, so that the greatest head in the aqueducts will be seen to be 27 feet.

The Forebay.

This building acts as an equalizing reservoir and also as a distributing chamber between the acqueducts and the penstocks, inlets being provided for three of the former and five of the latter. At present there are only two aqueducts and three penstocks. At the end of the forebay building, facing the river embankment, there is a syphon overflow for carrying off surplus water and for taking care of sudden fluctuations in level due to any abnormal conditions that might arise. The elevation at the forebay is practically the same as that at the intake, except for the slight difference due to varying load conditions and to friction and loss of head in the aqueducts.

The penstocks leading from forebay to the power house are of steel, 7 feet 6 inches in diameter, and about 800 feet



Interior of Power House, showing the three generator units. The third unit was installed recently.

in length. They are protected against frost by wooden housings covered with tar felt, in order to create a dead, or non-conducting, air space.

Valve Chamber, Etc.

The valve chamber is just outside the power house, and the penstocks are here tapped for the connections to the exciter units as will be presently explained. Between the valve chamber and the power house there is a building in which are located all the company's stores, toilet rooms, battery room, workshop and superintendent's office. In the basement are separate valve chambers for each penstock. These penstock valves are of the butterfly type, and are operated by water motors. As originally installed, it took two men twenty minutes to close each valve by hand. In order to provide against any emergency that might arise, water motors were afterwards installed, capable of closing the valves in about 30 seconds. The foresight and thoroughness of the company are well exemplified by such precautions as this, and account in great measure for the uninterrupted and uniformly satisfactory service given during the past six years.

View Below Main Dam.

The Intake House.

The Power House.

The power house is a reinforced concrete building, situated on the left-hand bank of the river, about 1-2 mile below the falls. The generator room is 300 feet long by 100 feet wide and is served by a 35-ton Niles electric traveling crane. All doors open outwards and protecting barriers surround all openings to cable ducts and to sub-chambers, which in turn are all connected to open drains. In this way the risk of damage to cables by flooding or leakage is greatly minimised. As above mentioned, the superintendent's office, battery room and workshop, are located outside the generator room, thus leaving the latter free of all obstructions, benches, etc.; consequently, the power house presents an extremely orderly and workmanlike appearance. The staff take great pride in keeping the house and equipment spick and span, and are strongly encouraged by the company to do so.

The original power installation, which, as already stated, commenced running in December, 1906, consisted of two 7,000 H.P. Voith twin turbines direct connected to two Canadian General Electric Company's 3-phase generators, generating current at 4,000 volts, 60 cycles.

Interior of Main Substation at Fort William.

As time went on, the district served by the company developed so rapidly that these two units proved unable to cope with the load, and in consequence, a third similar unit was installed in November last. The turbines are of the twin reaction type and operate under a head of 190 feet. They run at 277 R.P.M., the speed being regulated by Voith oil-pressure governors electrically controlled from the switchboard. The turbine efficiency is about 85 per cent. at 3-4 load.

Interior of Power House at Kakabeka Falls. Step-up Transformers in Foreground. Exciter Units in Centre Distance. Main Generator Units at Far End of Room. A Third Generator Unit has Since Been Added.

The generators have a continuous normal rating of 5,000 H.P. each at 85 per cent. power factor, 35 degs. rise, or an overload rating of practically 7,000 H.P. at 45 degs. rise. Transformers located in the power house step up the generator pressure from 4,000 volts to 22,000 volts for the transmission line, their neutrals being grounded on both the high and low tension sides. These transformers are of the air blast type, and are in three banks, each of a nominal capacity of 5,000 H.P. A spare transformer is carried in reserve. Protection is afforded to the high-tension bank switches and main line oil switches by overload inverse time limit bellows-type relays.

There are two exciter units driven by independent turbines. Each exciter has a capacity of 150 kilowatts, and is sufficient to take care of the five generators which will ultimately form the complete installation. The whole of the electrical equipment, including the switchboard, was supplied by the Canadian General Electric Company; and, togther with the turbines, has given the greatest satisfaction, no interruptions to service having ever been experienced from defective equipment, hot bearings, or similar cause.

Tail Race.

Since the power house is situated very near the edge of the river, a short tail race only is required to carry off the water. There is a concrete retaining wall between the tail water and the river, which permits a constant level to be maintained, and also facilitates the taking of accurate weir measurements for the purposes of tests. The turbines stand 18 feet above tail race level, and no trouble has been experienced with back water of any kind.

Precautions Against Ice.

Before dealing with the switchboard and transmission lines, it may be of interest to note some of the methods here employed to guard against interruptions to the service from ice in winter. The record of the Kaministiquia Power Company is almost unique in the history of hydro-electric power plants operated in cold climates; since, from the time the plant was first started-up, no trouble has ever been experienced from ice or other climatic conditions affecting the water supply. Much thought was given to the question at the time the plant was built, and special provision was made against ice trouble: (1st)—by having dead water in the service reservoir; (2nd)—by arranging for complete control of the river elevation; (3rd)—by providing outer protecting booms, trash racks and underflow gates; (4th)—by the special precautions (to be later described) taken at the intake house to avoid the formation of ice on the finer mesh and metallic racks and screens; (5th)—by carrying the concrete aqueducts completely below ground from intake house to forebay; and (6th)—by covering the steel penstocks with air-tight wooden housings covered with tar felt. Moreover, the turbines themselves are located inside the power house, and the draft tubes are protected by a water seal, which also maintains a constant head on the wheels. Hence, it will be seen that no parts where ice trouble could be met with have been left exposed.

The special precautions mentioned above as having been taken at the intake house are shown diagramatically in the line cut on page 89. The chamber marked A. is covered in on top by double flooring and tar felt, and a wooden partition at the front extends below low water level. In this way the chamber A. is insulated from the atmosphere, and is moreover heated by electric coils, so that it is impossible for cold air to be drawn down with the water. It is this drawing-in of cold air that causes mischief in so many plants. When once the ice has formed on the surface in winter, the water below it remains at a practically constant temperature. If, how-

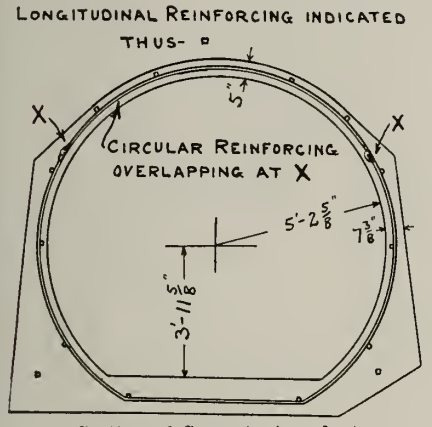
Main Office—Fort William Substation.

ever, air at a temperature of—say 20 to 40 degs. below zero—were drawn in at A., the water would immediately crystalise on the wire screens, and the trouble would steadily increase until no water could pass.

The means of overcoming ice trouble here illustrated have proved highly satisfactory in practice, and may prove of interest to superintendents and others who have been less fortunate in this respect than the Kaministiquia Power Company.

Main Switchboard.

In order the better to enable the operator to obtain a clear view all over the power house, and at the same time be undisturbed by any abnormal operating conditions, the main switchboard is housed in a double glass sound proof office situated on an elevated platform. This has been installed since our photographs were taken. The board consists of ten panels of blue Vermont marble, there being two line panels, five generator panels, two exciter panels, and one Tirrill regulator and local control panel.



Section of Concrete Aqueduct.

The operator has complete control of all remote oil switches for generators, transformers, lines, bus bars, etc.. and can tell by a glance at his meters the exact conditions existing at any moment in any part of his installation. All power house equipment, such as bus bars, switches, etc.. is in duplicate, thus making possible any combination of apparatus by interswitching, or allowing the plant to be run as two distinct and separate systems if necessary.

Transmission Lines.

The company's transmission lines are carried on duplicate wooden poles; two circuits on one pole and one on the other. Provision is made on the cross arms for a fourth circuit in the future. The lines are operated at 22,000 volts between phases, or 12,000 volts to ground, on a grounded neutral system, the neutrals being grounded on each of the 4,000 volt generators and on the neutral of the high-tension side of the step-up and step-down transformers.

The three main circuits are carried into the Fort William sub-station, which is the main distributing station on the system. Duplicate circuits are run to the Hydro-Electric Power Commission's substation at Port Arthur, and single circuits to the terminals of the Canadian Pacific and Grand Trunk Pacific Railways, with provision on the cross arms for duplication in each case.

Lightning Protection.

The original lightning protection installation was of the straight multi-gap type. During the first two years of operation experiments were made with the horn-gap type in series with liquid solutions and concrete block resistances. These have since been replaced on all lines and at the branch line substations with electrolytic arresters.

Sub-stations.

The main sub-station at Fort William is laid out for an ultimate capacity of 35,000 h.p. There are at present installed here two banks of step-down transformers of similar type to those at the power house, and in addition there is one reserve transformer. The transformer neutral at this station is grounded on the high-tension side only. The interswitching devices are very similar to those at the power house and mentioned above. Centrally located in the sub-station is a main control bench board for the control of all the main oil switches, high-tension line switches, and high and low-tension bank switches. Further equipment installed in this station includes two motor-generator sets, one being of 250 H.P. and the other of 500 H.P. generator capacity. The 250 H.P. set is driven by an induction motor, and the other by a synchronous motor. They deliver direct current at 550 volts into the system of the Port Arthur and Fort William Electric Railway.

Sub-station Switchboard.

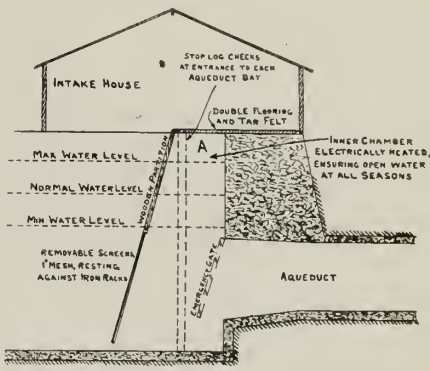
The sub-station switchboard at Fort William consists of nine panels of blue Vermont marble. Each panel has a capacity of 1,500 K.W., and carries duplicate oil switches and complete complement of meters and overload relays. This switchboard takes care of the general distribution to different parts of the city, except for the largest consumers and outlying points, which are fed direct by branch lines from the main transmission circuits. A motor-generator and battery set are provided for the operation of all the oil switches and to supply emergency lighting in the event of interruption to the main service. Thus, if a serious breakdown were to occur, the station would not be plunged into darkness, as several lamps located at essential points are kept burning all night from the battery set.

Relay Protection.

The three main lines are brought into the substation in multiple, and are protected by Westinghouse reverse current relays. The bank switches, both high and low-tensions, are protected by differential relays, which will only open their respective switches in the event of any trouble or short circuit in that particular bank. The distribution circuits are protected by overload and inverse time limit bellows-type relays. On account of the extra security afforded by three transmission lines, the relays are all set on a low time setting in order to eliminate trouble as quickly as possible and without loss of load.

Principal Customers.

The chief customers of the company include such large users of power as the C. P. R. with their extensive main line terminals and island terminals— the latter now under construction; the G. T. P. and their terminals, the city of Fort William, the Ogilvie Flour Mills Co.'s elevator and 3,500 barrel mill, the Canada Iron Corporation's local plant,


INTAKE HOUSE
STOP LOG GUIDES AT ENTRANCE TO EACH AQUEDUCT BAY
DOUBLE FLOORING AND TAR FELT
A
INNER CHAMBER ELECTRICALLY HEATED, ENSURING OPEN WATER AT ALL SEASONS
MAX WATER LEVEL
NORMAL WATER LEVEL
MIN WATER LEVEL
REMOVABLE SCREENS (MESH RESTING AGAINST IRON RACKS)
AQUEDUCT

Cross Sectional Diagram of Intake House.

and, with one exception, every one of the thirteen grain elevators in Fort William. The one exception is an outlying plant which was already equipped for a steam drive before the Kaministiquia Power Co. commenced operations.

Officials of the Company.

The executive officials in Montreal are:—

H. S. Holt—President.

W. A. Black—Managing Director.

J. Norris—Assistant Sec'y and Treasurer.

R. S. Kelsch—Consulting Engineer.

The managing and operating officials at Fort William and Kakabeka are:—

W. L. Bird, Manager and Secretary; P. R. Farrow, Power House Superintendent; W. J. Hoover, Line Superintendent; and E. Little, Operating Superintendent.

Our thanks are due to Mr. Bird for the facilities granted in the preparation of this article on the occasion of a recent visit, and for the photographs from which our cuts were made.

Boiler Explosions, Their Varied Causes and Prevention*

By S. F. Jeter**

The various features of the subject discussed in this article have been borne in on the author during a long period of observation and inspection of steam boilers of many types, and operating under a wide variety of service conditions. Safety is, and always will be the prime consideration to have attention, and those in charge of steam plants cannot help but realize that in many, if not all respects, the question is a very personal one.

THE causes of steam boiler explosions are so varied that it will only be possible to mention the more prominent ones in this paper. Broadly speaking, there is one explanation for all boiler explosions, namely, the boiler or some part of it is too weak to withstand the strain brought upon it. However, there are many causes contributing to such weakness. The public and many engineers assume that most explosions are caused by some mysterious influence which cannot be foreseen or guarded against, but as an actual fact, a definite cause can be given for most explosions of considerable violence. That a large percentage of boiler explosions are from causes that might have been foreseen and prevented, is a well established fact.

The Hartford Steam Boiler Inspection and Insurance Company's business during the past forty-five years has been built upon this idea, and their success and low loss ratio have demonstrated its correctness. Public opinion is being aroused to the fact that many boiler explosions are preventable, as evidenced by the present agitation for laws governing the construction and operation of boilers. The lead of the city of Philadelphia has been followed and improved upon by the State of Massachusetts, Ohio and several municipal governments have boiler laws patterned also after those of Massachusetts, and similar action is being seriously considered by a number of other states and cities. I can speak from experience gained in the manufacture of boilers, and I am sure you bear me out in the statement, that good laws on this subject, of uniform character, will be welcomed by the high-grade boiler manufacturer as a distinct aid tending to eliminate unfair competition.

Faulty Design, Grooving and Cracking.

The cause of boiler explosions with which I will deal first, because it is of particular interest to the manufacturer, is faulty design. Boilers are frequently constructed too weak for the pressure to be carried. This does not mean that the boiler will necessarily explode as soon as pressure is raised. Explosions from this cause usually occur after years of use, the overload on the parts having had time to gradually weaken them until they are no longer capable of resisting the excessive strain. Of course, a manufacturer has practically no control over the steam pressure to be used on a boiler, after he has delivered it to the purchaser. However, if the manufacturer should stamp his name and the safe working pressure for which it was designed on each boiler built, it would act as a protection to his reputation in the event of excessive pressure being used. Proper inspection and fixing of pressures by experts is the logical remedy for explosions due to this cause.

A fault of design which often leads to an explosion is the adoption of a shape which tends to deform under pressure. In such cases, if the movement produced occurs in narrow limits along fixed lines, grooving or cracking is almost certain to occur; finally causing an explosion, unless the defect is discovered before the structure has been weakened to the breaking point. The obvious remedy is to use shapes which internal pressure does not tend to change, and if this is impractical, to use such forms that the movement produced will occur over considerable areas and not be confined to narrow limits.

Improper reinforcement of openings has occasionally been the cause of boiler explosions. If the openings in boiler work were not generally of such moderate dimensions this might be a more frequent cause of disaster. It may be well to say here that no definite information is available regarding the distribution of stresses around an opening in a cylinder when subjected to internal pressure; consequently, the design for the reinforcement of such openings is by rule-of-thumb. Another cause of boiler explosions, where the design is primarily responsible, is when the arrangement does not permit of accessibility for the inspection of all parts. This is especially so when the inaccessible parts are located where rapid deterioration is likely to occur. No portion of the boiler proper should rest directly on a foundation or have any of its parts buried in earth or ashes.

A design which does not permit free circulation of water in all of its parts is liable to produce rapid internal corrosion, for unless a current is produced by a circulation sufficiently strong to remove all bubbles of air that may attach themselves to the surfaces, rapid corrosion is almost certain to ensue. This, if neglected, may result in an explosion. Air which is a mixture of about four parts of nitrogen to one of oxygen, together with very small quantities of other gases dissolves to a certain extent in water. However, the oxygen being more soluble than the nitrogen, dissolves more readily and the proportion of the gases found dissolved in the water are roughly one of oxygen to two of nitrogen, instead of in the proportions found in the air. When the dissolved air is liberated by the heat, the high percentage of oxygen causes the surface on which the bubbles may collect, to be rapidly corroded. This accounts for the severe corrosion of vessels containing water, which is merely heated without a strong circulation being produced.

A correct boiler design will provide uniform flexibility throughout. A stiff rigid part next to one which is flexible is a menace to safety if there is any tendency towards movement between the parts, either due to temperature changes or pressure.

Defective Workmanship.

Defective workmanship is responsible for some explosions. The barbarous practice of drifting rivet holes has doubtless contributed largely in the past to such accidents. The reputable manufacturer of to-day, however, will not knowingly permit such work. Lack of properly flaring the tubes and nipples in water-tube boilers has frequently resulted in explosions. The Hartford Steam Boiler Inspection and Insurance Company have always advocated proper flaring, and sometimes manufacturers have taken issue with the company on this point. Experience, which has cost the insurance company many thousands of dollars, has fully demonstrated the correctness of their position in this matter. The safety of the joints between a tube and plate when expanded and flared or merely expanded, is not a question of the relative strength of such connections newly made. When for some reason connected with the operation of

*Paper read at the 24th Annual Convention of the American Boiler Manufacturers' Association.

**Supervising Inspector, Hartford Steam Boiler Inspection and Insurance Co.

a boiler a connection of this kind becomes loose due to a movement of the parts from expansion or vibration, together with the excessive weight sometimes sustained, the tube or nipple with a flared end is merely expanded. The flared nipple usually gives warning of its looseness by leakage before it pulls out.

We all know from experience that the tendency is for employees to cover up mistakes in the shop. A manufacturer cannot guard his reputation from injury by this means too carefully. A loss of reputation for good work, after it has been well established, is many times more costly to the manufacturer in dollars and cents than the correction of errors before work leaves the shop.

Defective Material.

Defective material is sometimes the cause of boiler explosions, and the boiler manufacturer is largely dependent upon the producer of the material entering his product for protection in this respect. Nothing but material of the best quality should be specified for all parts of a boiler which are called upon to resist the strains produced by the pressure of steam, and every precaution should be exercised to see that such material is obtained. Cast iron should never be used in any part of a boiler required to resist tensile strains. This is in thorough accord with your views on the subject as expressed in your uniform boiler specifications.

Owners' Misconceived Ideas.

A cause of explosions, particularly reprehensible because of its being preventable, is due to an owner's willingness to pit his judgment against more competent or conservative advice. Often boilers are known to be in need of repairs, but the work is put off to a more convenient season. A feed pump refuses to start, and instead of fires being drawn as soon as the water reaches the lowest safe level, a chance is taken that it can be run a little longer. Pressures are sometimes carried higher than reasonable safety would permit, to avoid the expense of larger engines, or better boilers, and the latter are forced beyond a reasonable duty for the heating surface they contain. This is a feature that must be reckoned with more in the future than it has been in the past. Many engineers are apparently trying to discover by experiment the limit to the rate of transfer of heat from fire to water through the medium of boiler tubes and plate, and in order to show minimum investment and other economies, resulting from high rates of driving, are prone to advise overloads on both engines and boilers; all the while overlooking the all-important question:—is it safe?

Carelessness in Operation.

Boiler explosions are also the result of neglect or carelessness in operation. Scale and deposits are often allowed to collect in quantities that are dangerous; connections to water columns are allowed to become stopped; oil is permitted to enter the boiler with the feed water; repairs to settings which may affect the safety of the boiler are neglected, and safety valves are not regularly tested to ascertain if they are in operating condition. A steam gauge registers incorrectly and the engineer screws down on the safety valve in an endeavor to make them correspond. Again, the pressure of steam is not sufficient to produce the results desired, and the safety valve is deliberately made inoperative to overcome the difficulty. All of these conditions have been the cause of boiler explosions in the past, and they probably will continue to contribute their share in the future, until the steam user is more thoroughly educated in the matter of the risk he runs by such carelessness.

Water Tube Boilers.

Tube failures, which are chiefly confined to the water-tube type of boiler, are a source of grave concern to the boiler insurance interest on account of the difficulty to guard against the usual contingencies of this kind by inspection. A defective weld usually does not show on the surface of the tube, and even where the surface indications would lead to a suspicion, a large percentage of tubes in water tube boilers are beyond the reach or vision of the inspector. The thorough inspection of tubes before they are placed in the boiler, while very unsatisfactory, even taken in connection with the mill test, is about the only protection possible against accidents due to defects of manufacture. The seamless tube, of course, will prevent accidents due to defective welding, but tubes made by this process are not always of uniform thickness, and with the cold drawn product there are produced apparently internal strains in the process of manufacture which sometimes cause the tubes to break when merely heated. If cold drawn tubes are used for boiler purposes, the annealed stock should be obtained. Hot drawn seamless tubes are meeting with considerable favor among engineers for boiler purposes. A considerable percentage of tube failures occur without the slightest evidence as to their cause. A welded tube frequently breaks through the solid metal away from the weld, without being corroded or weakened in any way that may be detected by the eye, and without evidences of overheating. There must be some reason for such failures.

Thickness of Tubes.

It is a fact that while pressures and rates of driving have been remarkably increased the past 15 or 20 years, no increase in the thickness or strength of tubes has occurred. That the thicker tube is safer seems to have been demonstrated by a number of cases where heavy tubes have been put in place of those of standard gauge at the recommendation of the Hartford Company. Tube troubles have also ceased. Of course, it can be contended that the theoretical factor of safety is higher on tubes even of standard thickness than on almost any other portion of the boiler. However, under operating conditions accompanying high rates of driving, is it not possible that there are decided fluctuations in the temperature of the material in the tubes? The rapid formation of steam bubbles removes for a certain interval of time the water protection from the inner surface of a tube, and the thinner the material, the higher will its temperature rise during a given time in which it is not protected. It is conceivable that the structure of the metal in a thin tube may be affected in time by the constant change in temperature until it gives out, while the thicker tube might not be affected to the same degree by this means.

This idea is only advanced as a possible explanation for some of the tube accidents which seem to defy definite causes being assigned for them. The thicker material in the cases of welded tubes will make more certain that the required strength is obtained in the weld, also, surface imperfections in the material would not affect the strength to the same degree in the thick tube as it would in the lighter one. The importance of the question of tube failures to the operator of boilers as well as to the insurance interest can be appreciated when I say, as I believe I can conservatively, that the toll of loss of life and limb exacted by such failures probably exceeds other classes of boiler accidents when the relative number of fire-tube and water-tube boilers in use is considered.

Corrosion.

Corrosion has been the cause of many serious explosions, but with boilers built accessible for inspection, explosions from this cause may be reduced to a minimum where the boilers are under the care of a competent inspection service.

Improper Pipe Arrangement.

A source of explosions, external to the boiler itself, but which has produced very serious disasters, is the improper arrangement of steam piping. It is very dangerous indeed to attempt to connect a boiler to a steam line where the piping is arranged so that water pockets

may be formed. A water-hammer is likely to result in such cases which may break the pipe connections, and this in turn may produce an explosion of the boiler itself.

Lap Seam Cracks.

A source of very disastrous explosions have been the prevalence of the hidden crack or so-called lap-seam crack. The cause of these defects are either the form of seam, poor material, improper shape of the joined ends of the sheet, the abuse of the material in the process of manufacture; or possibly a combination of some of these causes. That the form of seam, alone, does not constitute the only factor, is well demonstrated by the fact that all lap seams do not fail in this manner and also that some seams of the butt joint type have thus failed.

It is, of course, readily recognized that with every precaution which can be taken, boiler explosions cannot be entirely eliminated, although their number may be lessened materially. A proper inquiry into every accident of this kind by Government officials qualified and clothed with ample authority to get at all facts in each case, and the blame, if any, placed where it properly belongs, would tend to this latter consummation. This is a feature we might profitably copy from our English cousins.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION IN 1913.

AT the Canadian Electrical Association's Annual Convention to be held in Ottawa in June next the question of the locale for next year's meeting will, of course, come up for settlement. We understand that the association is being strongly urged by the cities of Fort William and Port Arthur to hold the Convention at the head of the Great Lakes in 1913, and that the Executive Committee is inclined to give the application favorable consideration.

The recent great growth and progress in the twin cities doubtless entitles them to consideration. Hotel accommodation is good in both cities, which are connected by an excellent street railway system. Theatres, trips on Thunder Bay and other attractions abound, while the country round about is a paradise for the sportsman and angler. Interesting visits would be paid to the hydro-electric plant of the Kaministiquia Power Co., as well as to the Port Arthur power station on the Current River. The enormous electrically operated coal docks of the C. P. R. now under construction will form another feature of interest, as will also that of the Fort William Coal Dock Co. The large additions to the C. N. R. Coal & Ore Dock Co.'s plant at Port Arthur will be completed by next year, while the numerous grain elevators in both cities will attract many of the visitors.

In view of the foregoing, it will be conceded that the Association could not do better than hold the 1913 Convention at the head of the lakes.

AN OIL FUEL LOCOMOTIVE.

The first locomotive in Scotland to be fitted with fuel apparatus has just been put in service by the Caledonian Railway. The engine has an ordinary coal tender, but on the top of the tender there has been placed a tank having a capacity for 520 gallons of oil, from which a pipe is led to the furnace. The pipe branches out to either side, and allows the oil to enter through two injectors placed 18 in. apart. From these injectors the oil is sprayed into the furnace by steam, and is spread over the bars, and over a small quantity of coal which is required to facilitate combustion and to keep a fire in the furnace when the oil supply is turned off.

The oil feed is regulated by a controlling valve on each of the injectors, and the fire box is specially protected in order to withstand the intense heat. When drawing only the tender and one saloon carriage the fuel consumption is 1 1-2 lbs. per mile, and when drawing a full train it is 27 lbs. per mile. The present supply tank is sufficient for a run of 140 miles.

DURABILITY OF SMALL STEAM TURBINES.

A great deal is claimed for the durability of small steam turbines, and it is interesting to note facts which justify the same. The chief engineer of a large plant says that they call the unit there installed "the standby of the plant," as no matter what else broke down or gave out, the small steam turbine unit never failed, and the only thing they have done for this outfit for at least two years was to put oil in the bearings occasionally and wipe off the commutator. At the New York Edison Co.'s plant, 28 small turbines have not cost one cent for repairs since their installation, and some of them have been in use for five years.

HEAP & PARTNERS (CANADA) LTD.

Heap & Partners (Canada) Ltd. have opened an office in Montreal to handle the Canadian business of Messrs. William Heap & Co., Liverpool, England, an old established firm who have been entensively engaged in the home and export trade for the last fifty years. Heap & Partners are Canadian agents for David Colville & Sons, Motherwell, Scotland; Samuel Osborn & Co., Sheffield, England, and Thomas Piggott & Co., Birmingham, England, manufacturers respectively of steel plates and bars, tool and implement steel, welded and riveted steel pipe. They will also carry galvanized and black sheets of every description and cater for such requirements as gas engines and producers, high speed steam engines, air compressors, turbine pumps, etc.

Mr. C. E. Gausden is managing director of the Canadian Company, and Mr. A. H. Atkins, A.M.I.M.E., A.M.I.E.E., one of the directors, having charge of the engineering department of the Liverpool office is spending a few months here to help along the introduction of the various specialties. The firm have also on their staff, Mr. E. S. Wilson, Sheffield, England, who, for several years was connected with the manufacture of high-speed tool steels.

STATUS PRIZE.

The Council of the Society of Engineers (Incorporated), 17 Victoria Street, London, S.W., may award in 1912 two premiums of books or instruments to the value of $42.00 and $21.00, as first and second prizes respectively, for approved essays on the subject of "How to improve the Status of Engineers and Engineering, with special reference to Consulting Engineers." The council reserve the right to withhold either or both of the premiums if the essays received are not of the required standard of merit. The competition is open to all, but application for detailed particulars should be made to the secretary before entering. The last date for receiving essays is Friday, May 31, 1912.

CANADIAN ELECTRICAL ASSOCIATION.

This year's Convention of the Canadian Electrical Association will be held at the Chateau Laurier, Ottawa, June 19, 20 and 21. It will be the first function of this nature to meet at this magnificent hotel, which is now nearing completion and will be opened in May. Mr. J. H. Larmouth is chairman of the Papers Committee and an interesting Convention programme is being arranged.

The March issue of The Engineers' List contains a record of 26 buildings in New York City which have abandoned Edison service and are now operating private plants, having found the latter more economical.

Herringbone Gears---Features and Applications*

By Percy C. Day, Milwaukee. Wis. **

This paper relates especially to a type of herringbone gears, known as Wuest gears, after the name of the inventor. The distinctive feature is that the teeth on one side of the centre line of the face are stepped half the pitch ahead of those on the other side, so that they do not meet at a common apex at the centre line, as in the ordinary herringbone type. This arrangement makes it possible to hob the teeth by the aid of special machinery, and to secure great precision.

THAT the helical principle in toothed gearing is ideal from a theoretical point of view is well known. From a practical standpoint herringbone gears have been less satisfactory than straight-cut spur gears because, until recently, no method was devised for producing them with the requisite speed and accuracy. Within the last six years a method has been found and developed, in England, to a high degree of perfection. Herringbone gears made by this method are called Wuest gears, after the name of the inventor, and can be produced with even greater accuracy than cut gears of the spur type (Figs. 1 and 2).

The distinction between these gears and those of the ordinary herringbone type is that the teeth of the former, instead of joining at a common apex at the centre of the face, are stepped half the pitch apart and do not meet at all. This arrangement of the teeth does not affect the action of the gears, but it facilitates their commercial production and admits the use of precision methods in their manufacture. The utilization of power constantly calls for means to transmit rotary motion from one axis to another and to transform the speed of rotation. While there are many ways in which such transmissions and transformations may be produced, the merits of all of them must be judged from the following standards: (a) reliability and freedom from wear and tear; (b) economy of outlay; (c) mechanical efficiency; (d) compactness; (e) evenness of transmission, absence of shock, jar or vibration; (f) absence of noise. The order of merit may change with different applications, but the same standards obtain for all transmissions. The various methods employed are so well known that they need no discussion here. Let it suffice to say that the spur gear, which satisfies only the first four conditions is used to such an extent that all other appliances are relatively unimportant.

Fig. 2.—Gear and Pinion for 200 H.P. Turbine, to Run at 5,000 ft. per min.

The aim of all designers of gearing is to transmit rotary motion from one axis to another in a perfectly even manner without vibration.

In normal gears it is safe to aim at pitch line velocities between 1,000 and 2,000 ft. per min. with 1,500 ft. as a fair average. If the pinion is to be fixed to a motor shaft without external support, the diameter must be greater than when it can be supported on both sides. Cast-iron is preferable to cast-steel for gears of large diameters and moderate power, but the latter will be found more economical for high tooth pressures. Pinions are usually made from steel forgings of 0.40 to 0.50 per cent. carbon. Soft pinions should never be used for herringbone gears. Besides being bad engineering practice they are unnecessary, because steel pinions run without noise and last much longer.

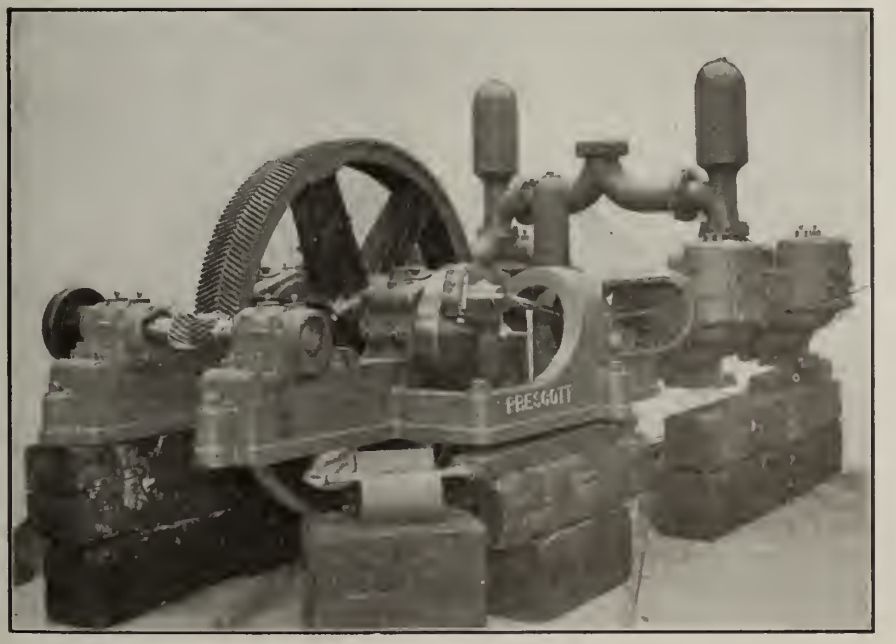


Fig. 4.—Gear-Driven Horizontal Pump, Gear Ratio 12¼ to 1.

Fig. 1.—Typical Herringbone Gear and Pinion.

* Presented at the annual meeting, Dec., 1911, of the American Society of Mechanical Engineers.

** Engineer with the Falk Co.

Typical Instance.

The following is a typical instance of the range of choice in dimensions:—A pump which requires 150 h.p. at 50 r.p.m. is to be driven from a motor at 500 r.p.m. with shaft end 4½ in. diameter. It the shaft is unsupported, it is not desirable to use a pinion of less than 10 in. If the shaft is extended to a third bearing a 7½-in. pinion can be used. If the pinion is cut solid on its shaft and coupled to the motor, its diameter can be reduced to 5 in. The three arrangements work out as follows:

		Material for Gear	V	P	K	Diametral Pitch	Face Width
A	10 in. and 100 in.	Cast-iron	1300	3800	500	2	9½
B	7½ in. and 75 in.	Cast-iron	975	5100	530	2	12
C	7½ in. and 75 in.	Cast-steel	975	5100	1060	2½	7½
D	5 in. and 50 in.	Cast-steel	650	7600	1150	2½	12½

Any of the above gears will do the work satisfactorily. C is the most economical, but B or D would make the least noise. If a gear case is to be provided, then D will give the most economical combination.

The foregoing data can be used for finding the required dimensions of herringbone gears for all general applications. In most cases it is sufficient to calculate the tooth pressure from the average working load. When the maximum load is very far in excess of the average, it is usual to take a mean value between the two. Gears for electric mine hoists and single throw pumps fall within this category. Machine tools, when driven from variable-speed motors, are required to perform maximum duty at minimum speed only for short periods at long intervals. It is sufficient when getting out gears for a drive of this kind to reckon with the rated output of the motor at the mean between its maximum and minimum speed.

Fig. 8.—Gear and Pinion for 500 H.P. Marine Turbine.

There are two special cases where the ordinary methods of calculation should not be used. Rolling-mill gears are subjected to stresses which are so far in excess of the average working load that it is necessary to consider carefully the strength of the teeth in regard to possible overloads. Extra high velocity gears, such as are used for steam turbines, require additional wearing surface and are characterized by extreme width of face combined with abnormally fine pitch. These are two extremes in gearing and their design is best left to those who have made a special study of them.

Summary of Gear Features.

Before describing some special applications of these gears to the needs of various industries and machines, it may be of service to summarize the salient features of the gears and the changes of viewpoint which these features have engendered. The smooth and continuous action is virtualy independent of the diameter or number of teeth in the pinion.

Extremely high ratios of reduction can be used without fear of uneven driving or undue wear and without fear for unwieldy gear diameters which would be disproportionate to the general design. High ratio gears of this type transmit power with practically no more loss than low ratio gears. They are far more efficient than belts, ropes, worm-gears or compound trains of spur gearing, while their adoption results in a wholesale reduction of countershafts and bearings which reduces the power consumption and running costs to a remarkable degree.

There are many instances where spur gears cannot be used because the vibration which they set up has a detrimental effect on the driven machine or its product. The inconvenience of a cumbersome system of belts or ropes has usually to be borne in such cases, but it is not too much to say that the requirements of almost all of them are fully satisfied by this type of herringbone gears.

The application of spur gears has been much restricted by the noise which they make when run at high velocities. The use of rawhide or other soft materials has only proved moderately successful for comparatively light work and is quite unsound for heavy gear practice. Herringbone gears in combination with durable steel pinions make less noise than soft pinions and spur gears when new, and while the former become quieter with use, the latter soon begin to rattle as they become worn. It should be noted that the use of soft pinions, while mitigating the nuisance of excessive noise, does not reduce vibration or unevenness of motion.

There is a limit to the pitch-line velocities at which spur gears can be operated and beyond which it is unsafe to use them. This limit is far below the minimum velocities which can be used in connection with steam turbines of economical design and high power. Accurate herringbone gears operate quite smoothly at velocities which are impossible for other types. This feature would appear to reserve for them a field of application which has great possibilities and is likely to cause some great changes in the standard practice of to-day.

Application to Steam Turbines.

There are many instances when the power of the turbine can be more conveniently applied in mechanical form than through electrical transmission. The advantages of high-power turbines have been discounted in many instances by the necessity for expensive electrical outfits with their attendant losses of generation, distribution and conversion.

Continuous Plate Mill Installation.

Mr. Parsons has made a successful introduction of herringbone gears in combination with a steam turbine for driving a continous plate mill. This is a proposition which few engineers would have considered seriously, yet it has proved a success from every point of view. The mill is of the three-high type with rolls 28 in. by 84 in. running at 70 r.p.m. The turbine is designed for mixed pressure, running at 2,000 r.p.m. with exhaust steam at 16 lb. absolute

Fig. 9.—Typical High Ratio Gear and Pinion, the Latter with 8 Teeth.

or live steam at 60 lb. absolute and giving 750 b.h.p. The turbine is coupled to the rolls through a double train of herringbone gears. The first train consists of a chrome nickel steel pinion, cut solid on its shaft and cast-steel gear. Pinion and gear have 25 and 131 teeth, 3½ diametral pitch by 24 in face. This train reduces from 2,000 to 375 r.p.m.

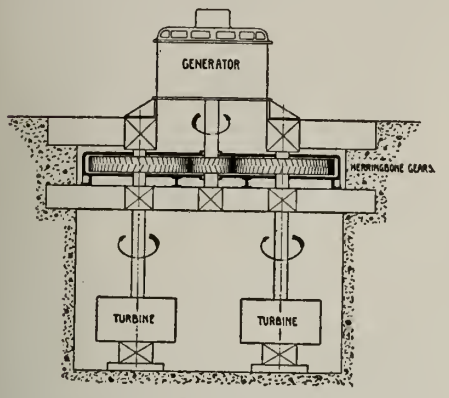


Fig. 3.—Diagram of Gear Connection Between Hydraulic Turbines and an Electric Generator.

and is coupled to the second train through a flexible coupling. The second train includes a high carbon steel pinion of 23 teeth and cast steel gear of 127 teeth, 2 in. circular pitch by 16 in. face. This train reduces from 375 to 70 r.p.m. The final gear is overhung on the end of a flywheel shaft 22 in. in diameter, which carries a flywheel of about 100 tons between two bearings and is coupled to the main pinion through a pair of wobblers. Both sets of gearing are enclosed in casings and are lubricated by oil jets from a pump provided for the purpose. This mill has been running without a hitch of any kind since September 15, 1910. The gears are noiseless, the installation shows remarkable efficiency, the rolls run with extreme smoothness and the pinions do not show appreciable wear.

Scope of Geared Turbine.

The success of the geared turbine for such an application as the one described makes it certain that similar arrangements can be used with advantage for driving textile and other mills where the conditions are less severe. The geared turbine is making rapid progress for driving direct-current generators, and several large sets are now running and in course of construction. Hitherto, it has been usual to couple the turbine to a high-speed alternator and to convert to continuous current through a motor generator or rotary converter. The geared turbine unit costs less money, takes up less space and has an overall efficiency at least 6 per cent. better than the A.C.—D.C. combination.

Geared turbines have another field of application for driving centrifugal pumps. Direct driven units of this kind have poor efficiency because a compromise has to be made between turbine and pump speed which is detrimental to both. The interposition of a set of herringbone gears allows both ends to be constructed for the highest economy, and since the loss in the gears does not exceed 2 or 3 per cent. there is a large all-round gain in efficiency. This applies also to turbine-driven blowers and fans.

Geared Hydraulic Turbines.

The speed of hydraulic turbines is controlled by the available head of water supplied to them. The greater number of turbines are required to operate under low heads and must run at slow speed. Hydro-electric power has usually to be transmitted to a considerable distance and is produced in the form of alternating current of definite periodicity. The speed of the turbines may be as low as 50 r.p.m. or even less. A large direct-coupled alternator for this speed is an expensive proposition.

Herringbone gears can be used to speed up from the slow-running turbines to generators of normal design, speed and efficiency. The smooth action of these gears is unimpaired when the wheel drives the pinion, and high ratios of speed increase can be obtained from them without noise and with less loss than direct coupled units will give. A typical installation of this kind is outlined in Fig. 3. This arrangement shows two slow-speed vertical turbines driving one generator. A herringbone gear is mounted on each turbine shaft and both gears mesh with a pinion which is coupled to the generator.

Rolling Mills and Rod Mills.

There are two advantages in the use of accurate herringbone gears for this class of work. The absence of shock in transmission renders breakages much less frequent than with cut spur or moulded

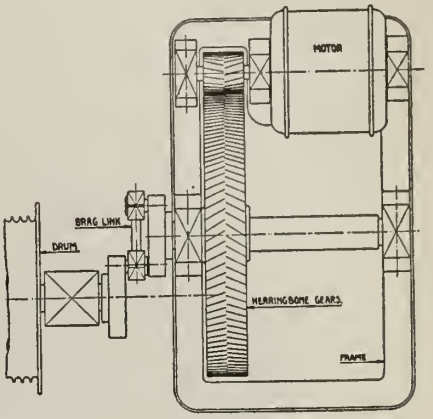


Fig. 7.—Electrification of Mine Hoist. Formerly Steam Driven.

helical gears. The even transmission and entire elimination of vibration allows the finishing rolls to be gear driven for the finest work without showing gear marks on the finished product. Herringbone-geared mills run with very little noise. This may be of less consequence in rolling mills than in most other applications, but it is an improvement. Rod mills, with their quantities

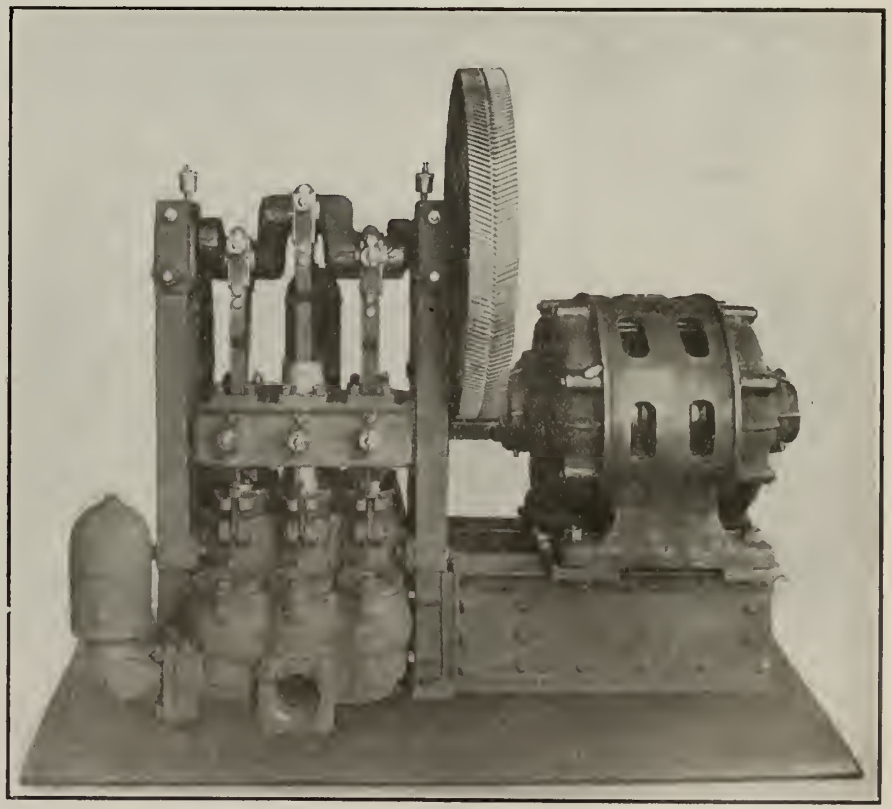


Fig. 5.—Herringbone Gears Applied to Electrically-Driven Triplex Pump.

of high-speed gearing, can be completely transformed by using herringbone gears and mill pinions.

Machine Tools.

The field for accurate herringbone gears in connection with machine tool driving is too extended to be considered in detail. For individual motor drives this gear gives a positive transmission which is free from vibration and less noisy than so-called silent chains or rawhide pinions, while there is no trouble from slipping belts or slack chains. But the real advantage of these gears lies in the better finish that can be obtained when they are used for the entire main transmission, and in the higher output combined with reduced maintenance which they give to heavy machine tools. Chatter is eliminated. Even the speeding up to the wheels of grinding machines has been successfully accomplished. Reversing gears for heavy planers are a revelation to those familiar only with the ordinary spur drive. Illustrations of machine tool drives are shown in Fig. 6.

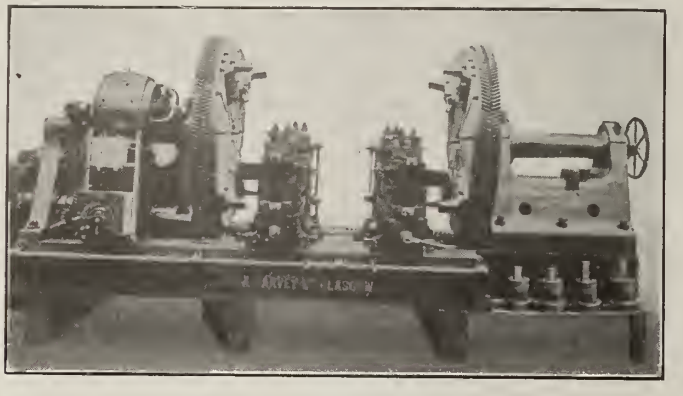


Fig. 6.—Tire Turning Lathe with Herringbone Gears.

Pump Driving.

Electrically-driven plunger pumps have not enjoyed the popularity that might be expected, due to the noise and vibration caused by the gearing between motor and pump shaft. These objections are obviated by accurately cut herringbone gears, which not only give silent and vibrationless transmission but admit the use of high ratio single reductions with compact dimensions. The single reduction drive has a much higher efficiency than the ordinary double frame, quite apart from the lower gear losses, because at least one countershaft can be dispensed with. Examples of such drives are shown in Figs. 4 and 5. Similar drives are successful for air compressors and vacuum pumps which present similar difficulties to those met with in plunger pumps.

Application To Mining.

One of the features in the recent electrifications of the Eckstein group of mines on the South African Rand is a train of herringbone gears between motor and drum in the main hoists. These hoists are driven by reversing asynchronous motors; the geared countershafts being connected to the drums by drag links from the original crank pins that were used when the hoists were run by steam power. The arrangement is shown in diagram in Fig. 7.

In installations of this type there are no slipping clutches, and the strains on the gears are very severe, some of them having to transmit 3,000 to 4,000 h.p. at pitch line velocities ranging from 2,000 to 3,500 ft. per min. The large coal mines in Northumberland, Yorkshire and South Wales are rapidly adopting high tension three phase current for the distribution of power below ground. Some very large main, tail and endless haulages are used in these, and herringbone gears have become a standard for this class of work. The hoists range from 30 h.p. up to 1,000 h.p., and invariably use a high reduction with ratios which are sometimes as great as 15 to 1. Simplification of design and saving of space is obtained in this way, since ordinary spurs require a double train. The gain in efficiency and absence of noise are remarkable, while the first cost of the whole outfit is often less than when cheaper gears are used. The elimination of all vibration prevents crystallization of the shafts and disintegration of the insulating material in the motors. These gears offer the same advantages for endless haulages. A higher speed motor can be used when they are adopted, while no more than two trains of gears are required.

An application of especial interest is for driving tipplers. These gears for this purpose have replaced worm gears because they stand up to the heavy strains without excessive wear. The available space for the gears is always limited in such cases. The gears have a ratio of 7 to 1 with a seven toothed pinion and a gear of only 20 in. diameter. One typical high ratio gear is shown in Fig. 9.

Elevators.

There are very few high buildings in Europe and the elevators there run at comparatively low speeds. As a consequence, worm gears predominate for this class of work. The Wuest type of gear was brought out with a view to overcoming the losses inseparable from worm gears with high ratios. The needs of American sky-scrapers have caused the development of elevators in this country to run on different lines, so that the popular type of to-day has the rope sheave direct connected to the motor. Needless to say the motor runs at exceedingly slow speed, usually not more than 50 to 60 r.p.m. as a maximum. Such a motor is expensive and inefficient. The system of control is wasteful to a degree. Field regulation is out of the question, and the speed control is obtained by shunting the main current through a resistance so as to reduce the volts across the armature of the motor. The survival of so uneconomical a type of machine is due to there having been no satisfactory gear system which would fit the peculiar conditions. A number of elevators are now being equipped with herringbone gears. The motor is geared to the sheave through a single train with a ratio of about 10 to 1. The maximum motor speed is about 500 r.p.m. and the speed control is nearly all obtained by simple field regulation. The following advantages are claimed:—The power consumption is not more than 60 per cent. of what is required for direct connected motors, the electrical switchgear is far more simple, has less to do and is not so liable to get out of order; the motor can be repaired without interfering with the car or its suspension.

The Falk Company, Milwaukee, Wis., has acquired the sole rights for the United States under the Wuest patents and during the past year have been constructing some of the most powerful gear-cutting machinery in existence with a view to securing the required degree of accuracy in the production of gears of this type.

NOVELTY IN TRAIN PROPULSION.

The Canadian Northern Railway have organized a subsidiary company which will operate between Lake St. Joseph and Quebec, a car whose motive power is electricity generated on board from a gasoline engine. The distance is 22 miles, and from 6 to 10 trips per day are reckoned to be made. The car will weigh about 40 tons and be provided with seating accommodation for 50 passengers.

ROLLER AND BALL BEARINGS.

By Prof. John Goodman, M. Inst. C.E.

FOR the past 15 years the author has been investigating the behavior of both roller and ball bearings, in order to find the load and speed at which such bearings may be allowed to run. The object of this communication is to lay before the Institution the results of a large number of tests of bearings, together with an attempt to reduce the mass of information obtained to a definite law. Two distinct types of testing machines were used: one for roller and ball bearings running on a cylindrical journal, and the other for thrust and collar bearings. These are described.

Roller Bearing References.

The common types of roller bearings are then referred to, and their relative advantages and disadvantages are discussed. Emphasis is laid on the serious troubles that arise from the end-thrust on the rollers The reason for the existence of end-thrust is dealt with and proposals are made for minimizing its ill effects. The machines used for measuring the friction of bearings and the end-thrust are described, and the results are tabulated. The tests show that the friction of roller bearings is much lower than that of ordinary bearings as commonly lubricated; the coefficient of friction is also more constant than with a plain bearing, being practically independent of speed and temperature. The starting effort of a roller bearing is little, if any, greater than the running resistance; a very important feature in machines which are constantly stopped and started. No satisfactory expression has been found for the safe load under which a roller bearing may be run. The various frictional losses that occur in a roller bearing have been analysed, and expressions are given for each.

Ball Bearing References.

Ball bearings are found to possess a great many advantages over rollerbearings; the friction is less, there is no end-thrust, and they occupy a much smaller length of shaft than either plain or roller bearings. Hertz's theory of the compression of perfectly elastic spheres and the stresses which occur in then when loaded is cited, and its application to the ball bearing problem is pointed out.

Very early in the author's experimental investigation it was found that the speed of rotation of the shaft and the balls makes a great difference to the working load that may be imposed on a ball bearing. It is shown that the centrifugal force acting on the balls does not materially increase the load upon them, hence the speed effect is not due to that cause. It is believed to have some relation to the well known effect of very rapid reversals of stress. The effect of running balls on flat and on grooved surfaces is dealt with, the experiments largely corroborating theoretical investigations.

The extreme importance of having all the balls in one race of exactly the same size, also of obtaining perfect truth and freedom from scratches in the ball races, is insisted upon. Expressions based on experimental data are given for the limiting working-load of ball bearings of both the thrust and radial types, and curves are plotted to show how the author's experiments agree with the tables found in makers' catalogues. The question of finding the load which will ultimately bring about failure in a ball bearing is one which presented some difficulty. Bearings which appear to be perfect to the naked eye after running for several months may ultimately fail if allowed to run for years. It is obviously out of the question to run test bearings for this length of time. Other methods, therefore, for detecting impending failure were tried, but without success, until the microscope was used for the examination of the balls. This method proved to be very valuable, and is believed to give entirely satisfactory results. The results of tests of ball bearings of different makes and designs are tabulated in an appendix. The design of bearings is also dealt with.

The author is of the opinion that modern ball bearings, as turned out by the best makers, are entirely satisfactory and reliable, and there is no reason to apprehend trouble with them. Reasonable care, of course, must be taken in mounting the bearings, and in ensuring that they are not allowed to run under higher loads than are given by the author's expressions. Ball bearings are more expensive to purchase than plain bearings fitted with ordinary lubrication, but the friction is about one-tenth as great, and the oil required is almost nil. When these qualities are taken into account, the ball bearing for almost every purpose is considered to be vastly superior to plain bearings. The paper, of which the foregoing is an abstract, together with illustrations of various types of bearing and curves giving the results obtained, was read recently before the Institution of Civil Engineers, London, Eng.

POWER COSTS.

THE following statement shows the cost of power in a number of prominent Canadian cities. It was embodied in a report made by a special Board of Trade Committee from data secured through investigation:.

Toronto—Hydraulic; 92 miles; light, 8c. to 3c., with discount of 10 per cent.; power, 5c. to ½c., with discount of 10 to 20 per cent.

Hamilton—Hydraulic; 32 miles; light, 2¼c., discount, 10 per cent.; installation free, power, $1.20 per h.p. per month.

Calgary—Steam and hydraulic; 35 miles; light, 9c., discount 15 per cent.; power, 2c. to 1 1-10, with discount of 10 per cent.

Winnipeg—Hydraulic; 37 miles; light, 7½c., now 3c.; power, 4c. to 1c.

Edmonton—Steam coal, $3 a ton; light, 8c.; power, 8c. to 3½c.

London—Steam and hydraulic; 150 miles; coal at $3 a ton; light, 4½c.; power, 3½c. to 1¼c. with discount of 10 per cent.

Vancouver—Steam and hydraulic; 17 miles; light, 11c. to 4c.; with discount of 20 per cent.; power, minimum charge of 2c.

Victoria—Steam and hydraulic; light, 13c. to 9c.; with discount of 1c per kilo-watt; power, 7c. to 2c.

Hamilton—Coal, $3 per ton; gas, $1.00 per 1,000.

Calgary—Coal, $2.62½ to $4 ton; gas, $1.75 to $1.35 per 1,000.

Winnipeg—Coal, $3.50 per ton; gas, $1.30 per 1,000; discount 10 and 25 per cent.

London—Coal, $3 per ton; gas, 95c. per 1,000.

Vancouver—Coal, $3.75 per ton; gas (a), $2 per 1,000, discount 25 per cent. (b), $1.50 to $1.25, discount 10 per cent.

Victoria—Coal, $3.75 per ton; gas (a), $2 per 1,000; (b), $2 to $1.50, discount 25c.

U. S. TURBINE ORDER FOR ENGLAND.

The Commonwealth Edison Company, of Chicago, probably the most important electric supply authority in the world, have decided to carry out some further extensions in connection with their Fisk street station. This station at present contains ten turbo-generators of 14,000 kw. each, and the proposed extensions will consist of four turbo units of 25,000 kw. maximum continuous load, and 20,000 kw. economical load.

The order for the first machine has been placed with Messrs. C. A. Parsons and Co., and it will be built at their works at Heaton-on-Tyne. The machine will generate three-phase current at 25 cycles and 9,000 volts, and will run at 750 r.p.m. In accordance with Messrs. Merz and McLellan's recent practice in ordering turbines of the reaction class. the turbine will be of the two-cylinder type, the high-pressure cylinder being a

single-flow turbine and the low-pressure cylinder a double-flow turbine. The high-pressure cylinder body will be of steel. The exciter will be direct coupled to the end of the alternator shaft. The current generated by the alternator will actually be at 4,500 volts, but will be stepped up to double that pressure by an auto-transformer to be supplied by the General Electric Company in the United States. The specified steam conditions are 200 lb. steam pressure, 200 deg. F. superheat, and 29 in. vacuum.

The supply company's extensions and the design of the turbo-generators are being carried out by Messrs. Sergeant and Lundy, the engineers of the company, in conjunction with Messrs. Merz and McLellan, of Westminster.

TWO INTERESTING BREAKDOWNS.

The current issue of Vulcan records two interesting breakdowns. One happened to a small vertical boiler with three large cross tubes in the fire-box. Opposite the top tube was a cleaning door, but the opening was not strengthened by a reinforcing ring. The boiler was left partially full of water, but with the fires out, in frosty weather. The water froze, and the expansion being very marked in the direction of the cross tubes stressed the boiler round the cleaning door opposite the top tube until the plate fractured. Apart from the weakness in design due to the absence of a strengthening ring, this failure indicates the error of leaving water and no fire in the boiler in frosty weather.

The other failure happened to a Diesel oil engine. The engine had four cylinders and as many cranks. One piston seized, but the fly-wheel momentum continued to turn the shaft. As a result, the cap bolts of the held connecting-rod broke, the connecting-rod itself was badly bent, the crank shaft twisted bodily through about 15 degs., and much minor damage was done. The seizure of the piston has not been fully explained, but there seems little doubt that it was due to overheating from some cause or other.

GRANTS OF WATER-POWERS.

The water-powers of Canada are among its most valuable possessions. To safeguard the rights of the public, the Commission of Conservation has adopted the following principles to guide it in formulating the opinions it gives on questions relating to the disposal of water-powers:

No unconditional titles shall be given to water-powers, but every grant or lease of powers shall be subject to the following conditions:

(a)—Development within a specified time.

(b)—Public control of rates.

(c)—A rental charge subject to revision from time to time.

THE CRAZE FOR HIGH SPEED.

Inventive genius saves time with a spoon for people who waste time with a shovel. For every ten minutes that labor-saving machinery "economizes" in the construction of a modern building, an hour is wasted by the sightseers who stand idle on the street and watch the machinery at its labor-saving work.

The telephone is a real blessing that degenerates into the curse of unnecessary talk. The typewriter becomes an agency for the multiplication of useless letters. The theory that this generation's time is precious, and there is not a minute to waste, is one of the superstitions of a deluded people who save hours on a journey in order that they may squander days at the journey's end.

Months for pleasure, but not a minute for safety, is the motto of this speed-crazed day and generation.—To. Tm.

TRANSMISSION MACHINERY CONTRACT COMPLETED.

In September last the Harbor Commissioners called for tenders on the transmission machinery for elevator No. 2, at Montreal harbor. The Dodge Manufacturing Co., Ltd., of Toronto, were sucessful in securing some 300 tons of the equipment; the last carload of which was recently shipped. This machinery was designed and manufactured throughout by the company in their Toronto plant, as was also, previous equipments for the Grand Trunk Pacific elevator at Tiffin, and for the C. P. R. elevator at Port McNicoll, Ont.

THE CANADIAN GENERAL ELECTRIC CO.

The Canadian General Electric Co., who at present occupy the building at the corner of St. Sacrament and St. Peter streets, Montreal, have purchased an extensive property on the south side of St. Antoine street, opposite the new Canadian Pacific Windsor street station, upon which they will commence this spring the erection of a handsome office and warehouse building to be used exclusively by the Canadian General Electric Co. and the Canada Foundry Co., Ltd. The building, which has been designed by Messrs. Ross & McFarlane, architects, Montreal, will be a handsome structure of cut stone and brick, consisting of five storeys and basement. The offices, showrooms, and warehouse floors will be equipped with every modern device for facilitating dispatch of business, and will afford ample space for the company's rapidly increasing trade.

The Canadian General Electric Co. have within the last two or three years either purchased or erected suitable buildings for their requirements in Halifax, Toronto, Winnipeg and Vancouver, and the erection of the Montreal building is in pursuance of their policy to provide every possible facility for taking care of the growth of business.

GRADED CERTIFICATES.

The correspondence received concerning graded certificates will not be published in our columns, believing as we do that its general tone is couched in such language as to engender strife among those who do not see eye to eye on the issue involved.

CENTRAL RAILWAY CLUB BANQUET.

Nearly two hundred attended the annual banquet of the Central Railway and Engineers' Club at the Walker House, Toronto, April 8th. The president, Mr. James Bannon, presided. Amongst those who spoke to the various toasts were: Dean Galbraith of the University of Toronto, Ald. Alfred Maguire and President Willis Chipman of the Engineers' Club.

DOUGLAS-MILLIGAN, LTD.

The agency business formerly operated under the name of Eadie-Douglas, Ltd., with head office at 12 University street, Montreal, has been re-organized and the name changed to Douglas-Milligan Ltd. Mr. H. G. Eadie has withdrawn from the concern, and the present organization consists of Mr. H. P. Douglas, president; Mr. G. M. Milligan, vice-president, and Mr. E. M. Watson, secretary-treasurer. The Toronto branch office is now under the management of Mr. W. F. Gouinlock, with offices in the Confederation Life Building, and the company is represented by agents in the leading cities throughout Canada.

It is said that from eight to ten thousand young men are annually enlisting in the ranks of the electric light and power industry. Good old Opportunity will soon be working overtime if he is expected to provide a rising chance for this multitude.—Ex.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. V. APRIL, 1912 No. 4

POWER GENERATION AND TRANSMISSION.

AT no previous periods in the commercial and industrial life of the world have the problems of power generation and transmission been so actively investigated and experimentally treated with a view to improvement on past conditions as the present and immediately preceding years have shown. Progress, which is well nigh revolutionary, has been and is everywhere apparent, and evidences are not wanting that the end of unsettlement caused is not yet measurably in sight.

Following the introduction of the reciprocating steam engine, a long period of development in the direction of design, efficiency and economy are to be noted, but in spite of this, little or no radical change took place in the basic features of either the steam generator and its motor unit. To-day we are beset with a host of competitors in the field of power generation, among which may be mentioned the steam turbine, the gas turbine, the oil engine, the water wheel, the water turbine, etc. Some of these are what may be termed still in a transition stage; being as a matter of fact yet immature in detail, so that widespread adoption has not been secured from power plant clients for general purposes. Others, again, have attained to a high state of perfection, but on account of being subject to local conditions they do not enter so effectively into many spheres of power requirement.

Development in the field of power transmission is a feature of present day progress which, as in the case of power generators, is also revolutionary. Transmission of electric power over wide territories is making rapid strides, and power generation, hydraulically, is on this account becoming more largely an effective competitor. Whatever the ultimate outcome, by which is meant the attainment of that stage in each of the departments already enumerated at which users may decide unhesitatingly and rely for a more or less lengthened period on a foundation principle type unit, we are of opinion that the field is wide enough to embrace them all, if only those who design, purchase and operate will cultivate and apply themselves to the acquirement of the best available knowledge and intelligence and do their duty. It should be particularly the part of the user and operator to keep in close touch with what is going on, as only by this means can either one or the other avoid being side-tracked.

Power transmission by rope, belt, gear or chain drive will, as in the past, be largely dependent on location and duty required, yet it should not be overlooked that in this, as in the generation feature there will be no standing still in improvement towards wider application; and here again the user and operator must display intelligence and acquire knowledge. This Annual Transmission Number of The Power House contains much information valuable to user and operator alike on the foregoing subject.

THE TRAGEDY OF THE S. S. "TITANIC."

IT is fitting, we believe, that reference be made in the columns of this Journal to the foundering of the Titanic on the early morning of Monday, April 15th, when over 1,600 persons met death and found a grave in the bosom of the mid-Atlantic Ocean.

We have reason to feel proud that the best traditions of the sea were observed in full degree by those prominent in the upbuilding of our Dominion, and that as the ice-chilled waters began to make insistent demand for possession of the ship, these quit themselves like men, and died as heroes. In spite of calumnious statements and slanders which no stretch of language can properly qualify, the silent yet intensely appreciable sympathy of the whole civilized world goes out to the bereaved relatives of the ship's crew from the captain down to the trimmer in the stokehold, and of those of the passengers of every class and position. All ranks and professions are the poorer for the loss of the activities of those who went down to death on the Titanic, but not in a long time has the honor roll of each had so many accessions as examples to those still in the struggle.

The wiseacres, as usual, have been busy after the event, some of whom were on board and many who were not. In either case, what they have to give out is for the most part equally valuable, for when consideration is taken of the gigantic proportions of the vessel—882 feet long, 94 feet wide, with her tier upon tier of decks—the narrators would require to have both the agility and intelligence of the "bee among benweed" to paint the picture, with even a slight semblance of reality.

What happened, why recall? The brave who died,
Died without flinching in the icy surf;
They sleep as well neath Atlantic's tide,
As others under turf.

They sleep as well! and roused from their wild grave,
Wearing their wounds like stars shall rise again,
Because they died to save the weak ones, not in vain.

—Ex. Altd.

GAS AND OIL ENGINE PROGRESS

A record of principles of design, construction and achievement in a rapidly developing sphere of power generation.

HIGH-SPEED DIESEL ENGINES.

ONLY three or four years ago, the high-speed Diesel engine was practically unheard of, but at the present time very large numbers of this type are being constructed and the orders on hand by European Continental firms run into thousands of horse-power—figures, in fact, which seem scarcely credible. The high-speed motor is a very natural evolution from the ordinary slow-speed type, inasmuch as engineers are now well accustomed to high-speed machinery, and after the general adoption of the steam turbine it was held to be something of a disadvantage of the Diesel engine that it necessitated a reversion to speeds of the opposite extreme.

Advantages of High Speed.

There are many purposes for which a high-speed prime mover is eminently desirable, and speed affects the cost not only of the engine itself but of the plant which it serves to drive. For electrical machinery a high speed of rotation is preferable, and, of course, though this may be obtained by belt driving, such a method is not one which can now be recommended. For pumps, ventilators, fans, blowers, and many other types of machinery a low speed of revolution is disadvantageous from all points of view, and it is, therefore, not difficult to see that an urgent need for a high-speed Diesel engine must of necessity arise. The advantages such a motor offers include a considerably lower cost for the engine itself and a decreased weight. A point of importance where engines have to be erected in confined spaces, as, for instance, the basement of buildings, as is so often the case, is that the room occupied is much reduced; in fact, in many instances it has been found that the high-speed engine afforded the only solution of the problem of getting the necessary power within the available space.

The average rate of revolution for Diesel motors of the slow-speed type varies between about 120 and 200 r.p.m., according to the power, while for the high-speed engine the corresponding figures are between 250 and 400 revolutions—a difference sufficient to cause distinct modifications in the design and construction. These modifications are such as almost invariably add to the expense of manufacture, so that the economy in price effected by the employment of the high-speed engine is not so great as anticipated; yet at the same time it is sufficient to be worthy of consideration in most cases, being in fact, usually somewhere in the neighbourhood of 15 to 20 per cent. The question would naturally arise as to the efficiency compared with the ordinary motor, but here there is little ground for objection; the difference being very slight—certainly not more than 2 or 3 per cent.—and quite insufficient materially to affect the running costs. The fact, however, that more lubricating oil is required is not to be lost sight of, since Diesel engines in any case consume a relatively large amount, which may cost anything up to 15 per cent. of the fuel oil, or even more.

The success of the high-speed Diesel motor naturally turns on its trustworthiness, and admittedly it cannot at present be accorded the same confidence as the slow-speed engine with which so much satisfactory experience has been obtained. The cost of upkeep in any machine having a high rate of revolution is necessarily slightly higher than in a slow-speed motor, however perfect its construction, and this point must always weigh slightly against the former; but it must be remembered that the Diesel engine is such a thoroughly trustworthy machine that too much stress must not be laid upon this point for the high-speed motor, in its essential principles, does not differ in the least from the slow-speed type.

Features of Design.

In practically all high-speed Diesel engines forced lubrication is adopted, and the crank chamber is enclosed; so also is the cam shaft, which thus runs in an oil bath, the effect being not only to reduce wear on the cams and levers, but to diminish the noise of the machine in operation. It has been found that the oil splashed up from the crank chamber to the bottom of the piston is frequently drawn into the space between the piston and cylinder liner, penetrating between the piston rings and carbonizing owing to the heat of combustion, with the result that the piston rings may stick and cause trouble. This trouble is avoided in some designs, notably that of the Augsburg Company, by having a piston ring towards the bottom end of the piston and holes bored in the piston walls between this and the top rings, so that the oil is discharged through the holes into the crank chamber again.

One of the chief considerations in the design of high-speed Diesel engines is the necessity of ensuring rigidity of the rods operating the valves, particularly those for fuel admission. In the motor of the type constructed by Messrs, Krupps the axis of the fuel valve spindle is inclined at an angle of 45 deg. to the horizontal, with the result that it can be actuated by a very short stiff lever from the cam shaft. In order that the oil may not be sprayed into the cylinder at an angle, which would be exceedingly disadvantageous, it is delivered through the needle valve and passes into the cylinder at the centre through about a dozen small holes bored in a horizontal mouthpiece. The starting valve for the admission of air, when running up the machine, likewise has its spindle inclined at 45 deg., and as in this case it is unimportant how the air enters the cylinder, the valve is fitted at the side quite close to the cam shaft, permitting of the employment of an even shorter lever than that required for the fuel valve.

In general design and appearance the high-speed engine does not differ much from the slow-speed type, except that its working parts are more enclosed, which makes it look a simpler machine, though it is not really so. There is no doubt that this motor will find very wide adoption for lower powers—say, up to 500 h.p.—and for many special purposes, of which driving ship's auxiliaries may be given as a good instance.

Contrary to what might appear to be the case at first sight, it is probable that the largest demand for Diesel engines will continue to be for relatively small

motors, in spite of the success of those built up to 2,000 and 2,500 h.p., for the reason that the constant efficiency of the Diesel engine—no matter of what power — avoids the necessity of having large units in order to obtain high efficiency, which is perhaps one of the chief reasons for steam plants of very high power. In fact, the view is held by many engineers on the Continent and also in Britain that the future tendency will be towards a decentralization of power, and that in most cases where central stations are now erected to feed sub-stations, it will be more economical to install prime movers (in the form of Diesel engines) at various points in the district where power is to be supplied. At present this is admittedly a debateable point, as so many considerations are involved, but such systems would certainly mean a very general application of Diesel engines of the high-speed types.—T. E. S.

The Chain Drive as a Power Transmission Medium

By C. T. R.

The contents of this article tell of the increasing popularity of the Chain Drive over a wide field of application and indicate that while its adaptability may be in numerous circumstances limited, there is, nevertheless, with the continued improvements being developed in design and quality of material, a strong possibility of its scope being still further extended.

ALTHOUGH the question of power transmission is only one of many to which the engineer has to give his attention, yet in these days of great and increasing activity, it comes about that none of us can afford to be indifferent to any factor which makes for better, quicker or cheaper production. Plants, factories and mills are extending in every direction as the supply falls short of the demand, and it is the engineer with the knowledge of where to save, who is mainly responsible for these extensions. That chain driving, which has many advantages over other methods of power transmission in many cases is a factor of considerable importance, is evidenced by the fact that in every part of the world engineers are using this drive to a large extent.

Record of Chain Drive Output.

Recent enquiry from the Canadian representatives of the originators and pioneers of chain driving, Hans Renold, Ltd., Manchester, England, elicited the information that this firm's output during the last five years, for chain drives for strictly engineering use was as follows:—

	H.P.
1907	30,500
1908	43,000
1909	48,100
1910	67,360
1911	99,600

Particulars of Installations.

The field of application for chain driving is unlimited. In Great Britain, drives ranging in size from ⅛ to 500 h.p. may be found doing duty under all sorts of conditions from the dish-washing machine in a provincial hotel, to the main shafts of mammoth steel rolling mills. Chain drives have been in operation with great success in the South African gold mines since the stamps first dropped, and one new textile plant in India has just placed an order for chain driving equipment valued at $30,000.

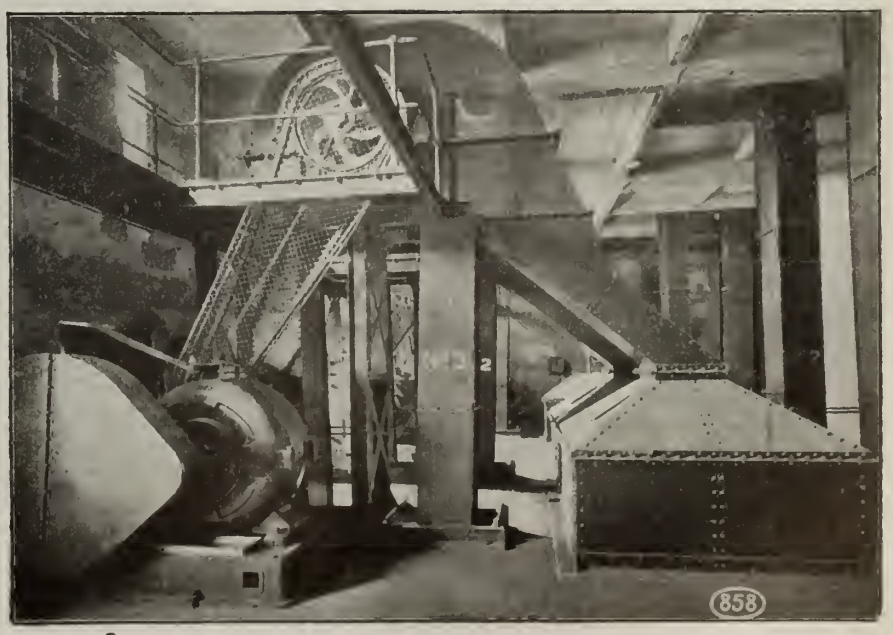
Canada has perhaps adopted chain driving more generally than other countries, as, of course, her development has taken place during the last decade. From Newfoundland to the lumber mills of the Pacific coast, from the hydro-electric stations at the Niagara Falls and the paper mills of the Soo to the Saguenay district and the mines of Northern Ontario, chain drives—which have proved their high efficiency and great durability under what were in many cases new and severe conditions—may be found. Nor does one find the chain drive used in isolated cases only. The experimental stage has long since passed, else one would not see such complete installations as that of the Wayagamack Pulp & Paper Company, who in their new mills at Three Rivers used over 40 Renold Chain Drives transmitting from 5 h.p. to 100 h.p.

One of the most interesting of the many complete installations of chain drives in this country is that of a prominent eastern firm who, having to increase their plant, duplicated the existing six-storey building, using similar equipment throughout the new addition, with the exception that the power was transmitted from one motor by means of chains to the different floors instead of by belt and ropes as formerly. Needless to say such a departure from old and tried methods was not made without the engineers studying carefully the advantages of chain driving generally.

Summary of Design and Application.

Space does not permit us to discuss the design of chains and their various applications, but it might be well to summarize some of the advantages:

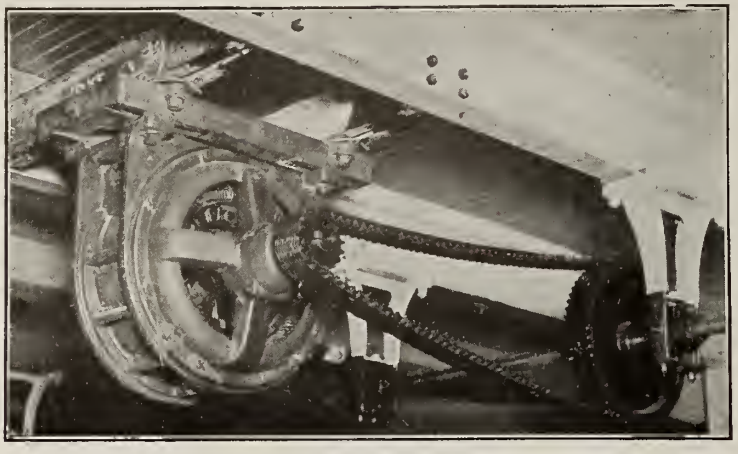
(1)—It is positive, inasmuch as the chain cannot slip in the wheels. It is elastic, inasmuch as the weight of the chain which hangs between the wheels may act as a spring; the lubricant in the bearings and in certain cases even the shapes of the links adding to this quality. The effect of this elasticity is to considerably reduce the vibration and noise which is inseparable from such a



One of eight drives forming part of an install ation of over forty Renold Chain drives in a grain elevator in Great Britain.

positive power transmission as spur gearing, while the positive nature of the chain drive has in many cases increased the production of machines from 15 to 30 per cent.

(2)—Chain driving is highly efficient; experiments having shown that the efficiency of a well-designed chain drive is somewhere between 97-98½ per cent.



One of five 35 H.P. Renold Chain drives installed by Jones & Glassco, Montreal, in a prominent new Montreal plant.

Also, the nature of the action of the chain upon the wheels is such that this high efficiency is maintained throughout the life of the drive and is not seriously affected by minute inaccuracies of erection, as is the case with some forms of tooth gearing.

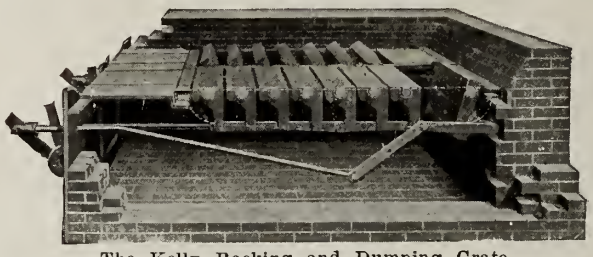
(3)—As compared with rope or belt, the centre distance for chain driving never exceeds 8 feet or 9 feet and can, if circumstances require, be made so small that the chain wheels barely clear one another. For this reason it is even possible to take out a pair of spur wheels, replace them by chain wheels of smaller diameter and get, as the result, a highly satisfactory drive as regards efficiency and absence of noise and vibration.

Partly on account of the above advantages, and partly because it is not necessary that there should be any greater initial tension in the chain than such as is caused by its own weight, there are very heavy incidental economies, effected by chain driving. The absence of tension results both in saving of power and in reduction of wear and tear of bearings, shafting and machine parts. In conclusion, we believe that chain driving —which must be classified among the prominent methods of power transmission for strictly engineering purposes— will continue to grow in popularity, and in fact, become recognized as a standard system.

THE KELLY ROCKING & DUMPING GRATE.

AN improved feature in a rocking and dumping grate is here shown. It consists of a large rear dump grate, which is operated independently from the main grate surface. By means of this double capacity dump grate, the largest clinker formations can be easily and quickly disposed of at the rear of the furnace where combustion ends.

The residue of combustion must be disposed of after the fuel has performed its heat producing function, and two ways only are available, namely, to dump into the ash pit or clean out through the fire doors. In modern furnace practice, the dumping process is considered the only right method, for there is a tremendous loss in furnace efficiency by the forward cleaning of the fires, because it disturbs combustion, and with the opening of the fire doors the heat producing function of the furnace is destroyed. The loss represents both fuel and labor in getting the combustive areas of the furnace back to a normal active state again.



The Kelly Rocking and Dumping Grate.

By referring to the illustration, it can be seen how the operation of cleaning this grate is performed, especially the rear portion, which, ordinarily, receives the least attention, because out of reach of the fireman. With this wide dump grate, the latter is really the easiest portion of the grate surface to clean, and can be done without extra exertion and exposure to heat and dirt. Although essentially a hand firing device, this grate embodies three prominent features of a mechanically fed furnace.

First.—The agitation and breaking up of the fuel bed by the rocking movement.

Second.—The tendency of the rocking motion to shift the fuel to the rear.

Third.—The large dumping grate at the rear of the furnace which enables the operator to dump the accumulation of clinker and ash.

The grate is the product of the Kelly Foundry, of Goshen, Ind., and is made to fit any size furnace, and with air space best adapted to the kind of fuel used.

Mr. William Storrie, chief assistant to Resident Engineer Longley, Toronto, has announced that he is quitting the civic service on May 1 to accept a position with the City of Ottawa. Apart from the consideration of a largely-increased salary, Mr. Storrie has been engaged to design and superintend the construction of a sand filtration plant for Ottawa, which is expected to cost about $600,000. The plant will have a capacity of 35,000,000 gallons. Mr. Storrie is a graduate of the Glasgow Technical College and had been in this country three years.

CATALOGUES.

The Armstrong Machinery Co., Spokane, Wash., manufacturers of ice and refrigerating machines, have got out a neat little 12-inch rule made of celluloid which they will be glad to mail to refrigerating engineers and others interested. The rule has a complete calendar for the current year printed on the back.

Experiments undertaken for measuring the temperature on the inner surface of the cylinder of a small gas engine have shown that the temperature is about 465 degrees F., and that the variation from cycle to cycle is usually less than 18 degrees F. The steady conditions of low temperature at the wall surface were caused by the jacket water, while very great changes of heat take place at a short distance from the walls.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

MOTOR-GENERATOR SET FOR LABORATORY SUPPLY WORK.

By H. T. Crosby.

THIS motor-generator set is intended to furnish the electrical machine laboratories of the Department of Electrical Engineering in the University of Toronto with power for testing and general experimental work. The power supply to the building from the local powerhouse is direct current at 110-220 volts, and while its voltage regulation does well enough for commercial purposes, it is not close enough for testing. This apparatus will supply alternating current as well as direct-current at 110 volts as required, and voltage and frequency will be under control in the laboratory. The set consists of a direct-current motor driving an alternator with its exciter and a direct-current generator; all direct-connected and mounted upon the same bedplate. The ratings of the separate machines are as follows:

D. C. Motor.—Volts, 220; amperes, 240; speed, 900 r.p.m.; h.p., 65.

D. C. Generator.—Volts, 110; amperes, 273; k.w., 30.

Alternator. — Volts, 110; amperes, 158; cycles, 60; k.v.a., 30.

Exciter.—Volts, 110; amperes, 11; k.w., 1.2.

Machine Particulars.

The motor is of the shunt wound type and is fitted with interpoles; four field poles and two interpoles comprising the field structure. It is placed in the centre of the set, between the direct-current generator on the one hand and the alternator on the other.

The direct-current generator is compound wound, with both series and interpole winding. The field structure here, as in the motor, consists of four field poles and two interpoles. The field rheostat of this machine has 60 ohms resistance and will carry 4 amperes, which is sufficient for all conditions of operation. The generator voltage, with field rheostat all in, will drop to 9 volts, and with rheostat short-circuited will rise to 154 volts, showing limits and speed of regulation that may be expected.

The alternator is of the revolving field stationary armature type and is excited by the direct-connected exciter mentioned above. The armature core is of laminated Swedish sheet iron, provided with the usual ventilating ducts. The coils are form wound and placed in slots of the half-closed type. The winding is star-connected and has the neutral brought out to the terminal board.

The alternator field consists of a cast iron spider to which are bolted the wrought iron field poles with their coils. The slip rings are of brass and provided with double brush holders and carbon brushes.

Guarantees and Connections Data.

As the set was supplied under guarantees as to voltage regulation of alternator and temperature rise on any part of machines, it was subjected to a heat run of 10 hours in order to determine the final temperature rise and also to test the machine for efficiency, etc., while running at that temperature. Specifically the voltage regulation of alternator was to be 7 per cent. at unity power-factor and 16 per cent. at 80 per cent. power-factor (current lagging); temperature rise in no case to be above 40 degs. Centrigrade, measured by thermometer. In the absence of permanent wiring for the apparatus, temporary connections were used as shown in Fig. 1. The method adopted was briefly that of loading the alternator with two 15 k.w. alternators run as synchronous motors.

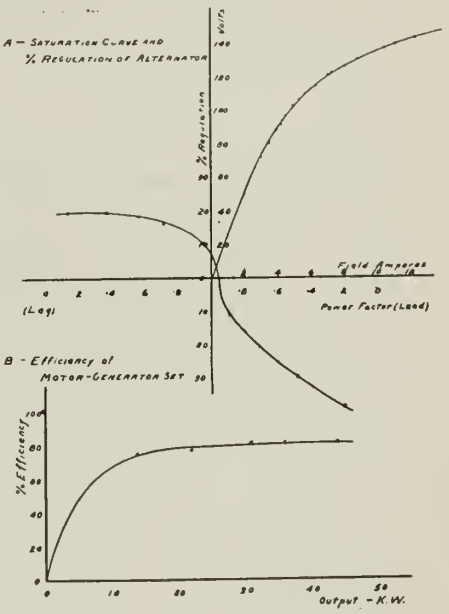


Fig. 2.

Each of these machines is ordinarily driven by a 220 volt D.C. motor, being direct-connected. Here, we excited the fields of the D. C. motors above normal by putting the two halves of the field windings in parallel so that they fed back on the supply system. This effected a loading-back system which was more flexible and more convenient than dissipating all the load as heat in rheostats or lamps. The motor being rated at 65 horse-power and the alternator at 30 k.w., therefore in order to fully load the former, the alternator was full-loaded and sufficient load put on the D. C. generator to bring the motor input up to rated value—240 amperes at 220 volts.

Test Data From Heat Run.

Data obtained during the heat run is

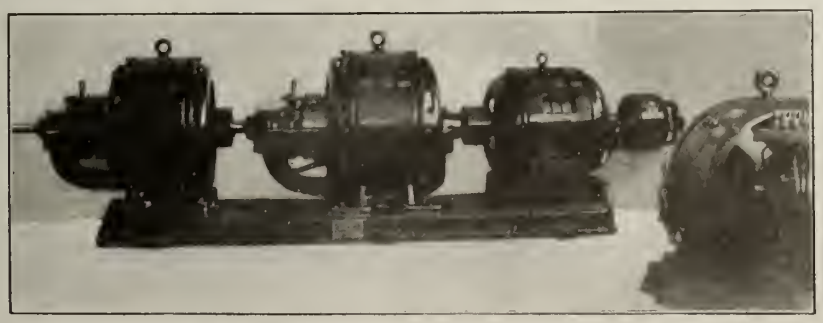


Fig. 3—Motor Generator set for laboratory supply work.

shown in table I. Readings of input and output also temperature readings by thermometer were taken hourly; and in addition, data to determine temperature by resistance as well as brush and brush contact resistance, etc. Conditions were watched carefully throughout the time of running and kept constant.

The results show the greatest rise in temperature above room temperature to be on the motor interpole winding, where 33.4 degs. centigrade was observed. For other parts of machines, these temperature rises were registered:

Pole tip on motor field ....30.5 degs. C.
Motor shunt field winding..27.5 degs. C.
Motor armature surface ..20.9 degs. C.
Motor commutator surface. 9.6 degs. C.
Alternator winding ..... 15.9 degs. C.
Alternator armature iron . 16.7 degs. C.
Alternator field winding .. 9.1 degs. C.

By resistance method, temperature rises were estimated as follows:—Motor interpole winding, 65 degs. C.; motor shunt field winding, 59.6 degs. C.

TABLE I, PART I.
READINGS ON MOTOR.

	VOLTS.				AMPERES		TEMPERATURES, BY THERMOMETERS		
Time.	Line.	Field.	Inter-pole.	Brushes.	Line.	Field.	Pole.	Inter-pole.	Room.
8.00	220	171.0	.8	1.05	241	2.18	17.7	18.5	20.0
9.00	216	168.0	.95	.78	243	2.02	30.7	50.0	26.5
10.00	214	176.0	.98	.6	238	2.06	41.2	52.5	24.5
11.00	213	181.0	.99	.65	237	2.05	49.2	53.4	24.2
12.00	218	193.0	1.00	.7	238	2.18	50.2	52.5	24.1
1.00	221	203.0	1.00	.55	240	2.28	51.2	53.5	24.5
2.00	220	205.0	1.00	.65	240	2.28	52.2	54.5	24.4
3.00	221	210.0	1.00	.56	242	2.32	53.0	55.8	24.0
4.00	221	213.5	.98	.5	238	2.33	53.3	55.3	24.3
5.00	222	213.5	.99	.4	240	2.34	53.5	55.8	24.4
6.00	221	198.0	1.00	..	238	2.16	53.9	57.3	24.9

TABLE II.

PART I. Saturation Curve Data		PART II. Load Test				
Field Amps.	Volts.	Volts.	Amps.	% P.F.	Field Amps.	% Regl'n.
2.6	66.0	110	160.0	13.7	9.05	19.6
3.0	72.0	110	158.5	37.5	9.15	19.8
3.5	80.5	110	159.0	56.0	8.65	17.72
3.98	88.0	110	159.0	71.5	8.3	16.35
4.21	91.0	110	158.0	97.0	7.1	10.0
4.38	94.0	110	158.5	89.0	4.7	10.9
4.57	96.5	110	158.0	80.0	4.3	15.9
4.81	99.0	110	157.0	72.0	3.95	20.2
4.95	103.0	110	159.0	48.5	3.3	29.5
5.28	106.2	110	158.0	20.0	2.75	39.0
5.66	109.8					
6.29	114.8	Frequency constant 60 cycles				
7.08	121.0					
7.28	122.2					
8.08	126.0					
8.96	130.3					
10.55	136.8					
11.2	138.8					
12.45	142.5					
14.55	147.5					

Temperature rises in exciter were not taken, being quite small, as it was operating under a load of hardly more than 6 amperes at any time; the exciter being rated for 11 amperes. This latter exciting current will hold voltage on alternator with almost zero power factor.

For bearings, the temprature rise was in no case over 12.5 degs. C., which, as will be noted, are very moderate.

Alternator Regulation.

While machines were still warm, readings were taken for alternator regulation by load test at different power factors. Control of power factor was readily obtained by variation of relative excitation of synchronous motors and alternator. Similarly, the load on alternator was controlled by regulation of field rheostat of D. C. motors (operating as generators.) The saturation curve of alternator is shown in Fig. 2, being obtained from readings in table II, Part I. Part II shows the other readings taken to obtain the regulation curve shown also in Fig. 2. Regulation is seen to be 7 per cent. at 100 per cent. power factor, and 15 per cent. at 80 per cent. power factor. Values for practically all power factors are shown.

Efficiencies.

Efficiencies at various loads were obtained for the set as shown in table III. The highest value reached was 82.9 per cent.; the motor and alternator then being under full load and the D. C. generator under approximately 45 per cent. load. At full load the average efficiency of the machines must be over 91 per cent., although the efficiencies of individual machines is not readily obtained with accuracy, due to inability to separate the stray power of the set into proper proportions chargeable to each machine.

Notes on Arrangement.

The starting of the set was accomplished by means of two solenoids which short-circuited first a part and then the whole of the starting resistance. These solenoids are arranged so that the plunger closes the circuit, i.e., short circuits its portion of starting resistance when the current has dropped to 40 amperes. The second coil has a shunt winding which holds circuit closed until voltage is removed from the circuit.

The power factor for alternator was measured by two series transformers and a single phase power factor meter. Connections of the same are shown in Fig. 1. Rating of series transformers used was 100-5 amperes, and as current in each line was 158 amperes, the two transformers were put in the line in parallel on the primary side and in series on the secondary. Thus, the primaries would share current about evenly and no appreciable error should be introduced in power factor indication. The voltage impressed on this meter was that between the line containing the series transformers and the neutral of the alternator winding which is brought to terminal board as mentioned above.

TABLE I, PART II.

	ALTERNATOR										D.C. GENERATOR		
				Amperes		Volts			Temperatures by Thermometer.		Volts.	Amperes	
Time	Volts Load	Amps. Load	Frequency.	Generator Field	Exciter Field	Generator Field	Exciter Field	Power factor	Alternator Winding	Armature Iron	Load	Load	Field
8.00	110.0	154.0	60.0	5.8	.375	47.0	44.0	1.00	18.5	18.5	96.0	121	1.95
9.00	110.0	155.0	60.5	5.9	.38	48.0	45.2	.995	35.2	36.0	99.0	130	1.97
10.00	111.0	154.0	61.0	6.1	.355	50.5	43.5	.99	36.5	38.0	96.5	128	1.9
11.00	109.0	158.5	59.5	5.95	.349	50.0	43.5	1.00	38.0	40.4	96.0	126	1.89
12.00	110.0	157.5	60.0	5.95	.345	49.6	43.2	.99	38.3	40.8	100.8	132	2.09
1.00	111.0	157.5	60.5	6.0	.35	50.0	44.0	.99	38.0	40.6	103.0	138	2.23
2.00	110.0	160.0	60.0	5.75	.35	48.4	44.0	.98	39.2	41.1	102.0	136	2.11
3.00	110.5	157.0	60.0	6.15	.345	52.0	43.5	1.00	39.8	41.2	102.0	137	2.08
4.00	110.0	157.0	60.0	5.93	.35	50.0	43.5	.99	40.1	41.2	100.0	133	2.03
5.00	109.0	157.0	60.0	5.98	.35	50.0	43.5	.99	40.3	40.8	100.6	134	2.05
6.00	110.0	161.0	60.0	6.0	.35	50.3	44.0	.99	39.4	40.8	99.0	131	2.0

TABLE III.

Input			Output			Output	Total	%
Volts.	Amps.	Watts.	Volts.	Amps.	Watts	Volts.	Amps.	Watts.	Output	Eff'cy
221.0	238	52,600	110	161.0	30,600	99	131.0	12.95	43,550	82.9
222.5	200	44,600	110	159.5	30,400	63	87.5	5.52	35,920	80.7
224.5	165	37,050	110	160.5	30,600	..	.....	.....	30,600	82.6
225.0	125	28,150	110	115.0	21,900	..	.....	.....	21,900	77.9
226.5	80	18,100	110	72.4	13,800	..	.....	.....	13,800	76.3

ELECTRIC MOTOR BREAKDOWN.

An interesting illustration appearing in the current issue of the Vulcan shows a breakdown which occurred recently to a 100 horse-power electric motor. This machine, which worked on a 220-volt circuit running at 600 revolutions per minute, was of the open type, fitted with interpoles. The breakdown occurred to the short circuit, probably at the field regulating switch, with the result that the machine lost its excitation and the motor ran at an excessive speed. Before it could be stopped the band at the coupling end broke, and the centrifugal force caused the armature wires to fly outwards and to foul the field coils, with the result that both armature and field coils have had to be completely re-

wound. The high speed was only maintained for a few moments, but during that time the damage was done, and the fouling of the armature wires on the fields acted as a brake, and caused not only the core plates to be twisted on the spider, but the shaft itself to be bent.

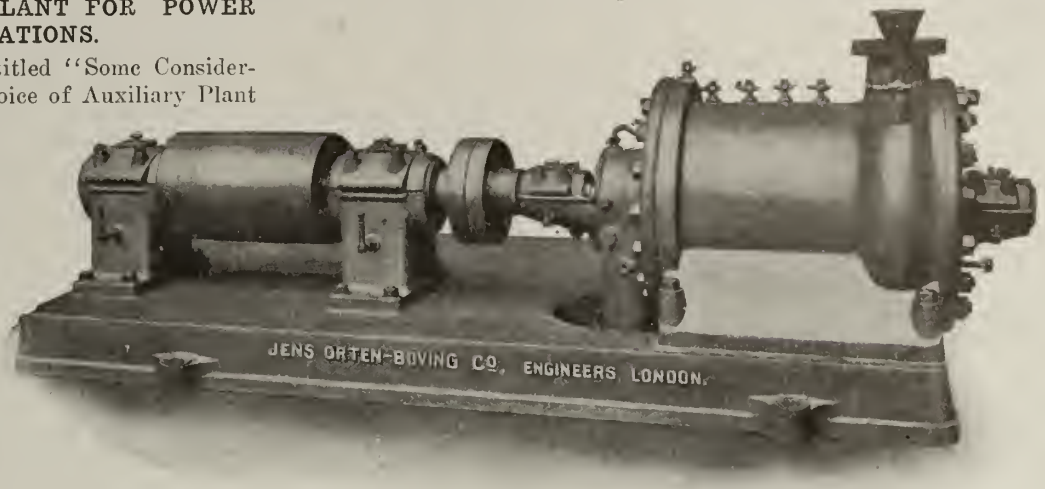
AUXILIARY PLANT FOR POWER STATIONS.

In a paper entitled "Some Considerations on the Choice of Auxiliary Plant for Power Stations," read before the North-East Coast Institution of Engineers and Shipbuilders by Mr. A. H. Finch, the opinion expressed is that the following may with advantage be electrically operated:—Mechanical stokers, if fitted; fans, if fitted (variable speed motors are desirable here, if efficient at low speed); water service pumps of all sorts, except those very rarely used, economiser scrapers; coal and ash handling plant; cranes.

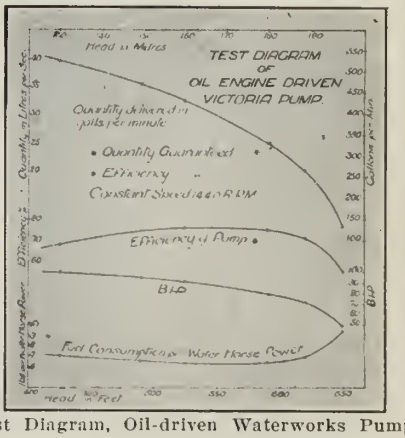
OIL ENGINE DRIVEN WATER-WORKS PUMP.

AN interesting pump for pumping directly into a water supply main has recently been installed by Jens Orten-Boving & Co., London, England, the parent company of the Canadian Boving Company, Limited, Toronto. It is a six-stage "Victoria" pump, and is shown in the accompanying illustration. It is specially designed to work against widely varying pressures without setting up end thrust; having a patented thrust balancing device which automatically adjusts itself to changes of pressure occurring when the water main is partly or entirely closed.

The diagram shows the results of tests on this pump under normal and abnormal conditions. Against a total head of 580 ft., a delivery of 310 gallons per minute and an efficiency of 70 per cent. were guaranteed. Under tests at this head, 350 gallons per minute were obtained with an efficiency of 75 per cent. It is particularly interesting to note that the guaranteed efficiency of 70 per cent. was obtained under heads varying from 450 ft. to 620 ft., once more emphasises the enormous advances which have been made during recent years in the efficient design of turbine pumps. The oil-fuel consumption of the engine driving this pump was 0.45 lbs. per brake horse power hour.



Oil Engine-driven Water Works Pump.



Test Diagram, Oil-driven Waterworks Pump.

Owing to the high ratio of transmission, the efficiency of the belt drive was only 93 per cent., and with the pump efficiency at 75 per cent. the total fuel consumption per horsepower hour is:—

$$\frac{0.45}{0.75 \times 0.93} = 0.65 \text{ lbs. only.}$$

In order to prevent undue stress being transmitted to the pump shaft, a flexible coupling is inserted between the transmission shaft and the pump.

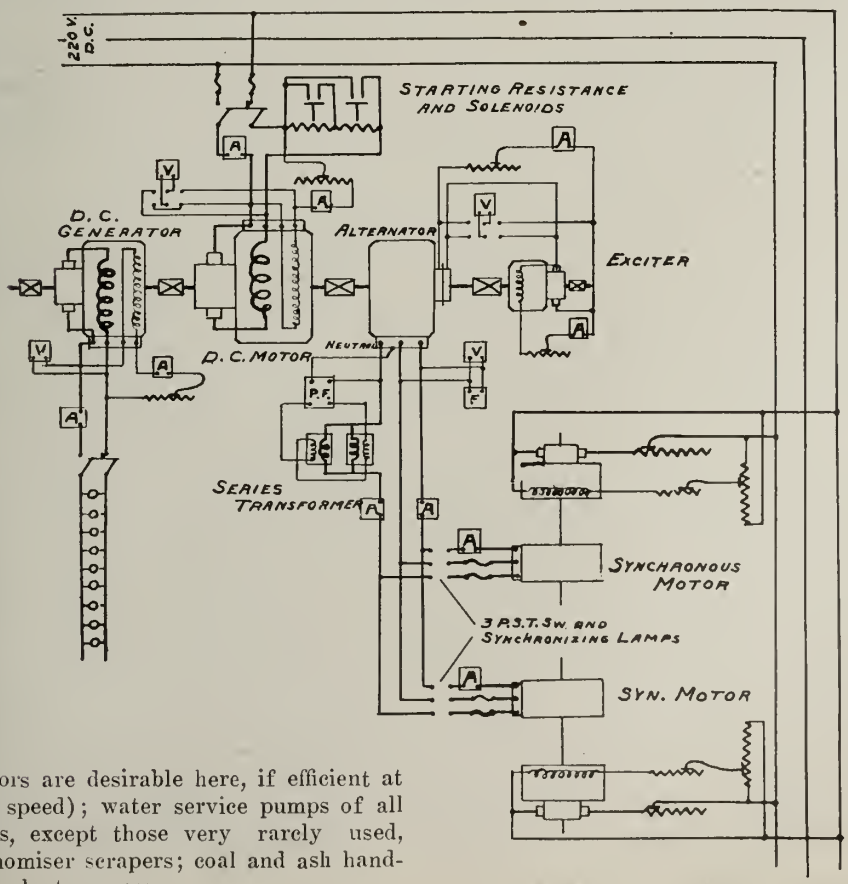


Fig. 1—Wiring Diagram, M.G. set loaded.

REFRIGERATION DEPARTMENT

AMMONIA REFRIGERATION.

By W. G. Walters.

USERS of ammonia refrigerating machines arrange their plants in manner that best suits their special requirements or accommodations. They are also much influenced in the selection of a particular type of machine by the efforts of the salesman who first locates the prospect. In this article we will discuss what is known in refrigerating circles as "Wet v. Dry Compression."

Considerable energy has been expended in setting forth the relative merits of wet or dry compression and the end is not yet. The arguments presented are generally interesting and instructive though not conclusive because there is generally something left out. The fact remains that there are advocates of both

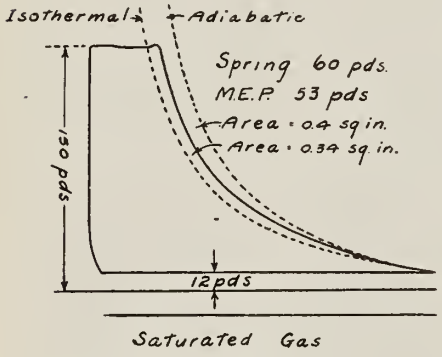


Fig. 1.

systems. We find engineers who are using the wet compression who practice what they preach to the extent of doing away entirely with all other methods of cylinder cooling. The machines are also evidently giving complete satisfaction. Again, it is not certain that those who advocate dry compression adhere to their method exclusively. The usual water jacket may be in use, and in addition some unevaporated vapor may be drawn into the cylinder to assist in the cooling. In such circumstances, the saturated condition prevails for at least a part of the period of compression.

The term wet compression is applied, strictly speaking, to compression with the medium in the saturated condition throughout the whole period. In other words, it applies to the compression of a vapor. Dry compression on the other hand would apply to the compression of a gas. It is evident that between the two extremes there is a limit to the number of degrees of humidity that may prevail. There is no doubt but that with a given pressure, the degree of humidity would have some bearing on the temperature and work of compression. When a gas or vapor is compressed, the heat generated in the mechanical work of compression raises its temperature and pressure; consequently its pressure is more rapidly raised than would be the case if it could be maintained at a constant temperature. In the dry compression systems, the cylinders are water jacketed to remove this heat of compression; but it is found in the majority of cases that the jacket is inadequate for the performance of its duty in the cooling of this unit. The cooling effect of the jacket is largely a skin phenomenon, limited at high speeds to a thin layer on the interior of the cylinder walls. The type of compressor using an auxiliary circulation was designed for the purpose of producing an internal water jacket in its effect, and for the elimination of clearance evils as well. It is recognized by all refrigerating engineers that the less clearance there is, the higher the efficiency of the machine.

Dry Compression.

In dry compression, the ammonia vapor is essentially a gas and similar in its actions during compression to air in its effects in the ordinary air compressor. Cylinder heating is very great—the mean effective pressure throughout the stroke is much higher than is necessary, and the clearance effect is at its maximum. A certain amount of ammonia, however, passes through the cylinder at each stroke and this amount can be easily determined by knowing the size of cylinder and can always be relied upon, for every pound of ammonia gas which is passed through the cyclinder is used for the production of refrigeration. One of the strongest objections to the dry compression is the detrimental effect of the heat of compression on the valves and piston, and the unsatisfactory methods employed to remove this heat. When ammonia gas is compressed from a pressure of 24 to 28 lbs. up to 170 or 180 lbs., a very considerable amount of heat is developed and transmitted to the compressor cylinder and all its parts. This is why water jackets are employed in an attempt to remove the compression heat; but as the water does not reach the piston and valves, oil is injected, which to some extent assists in the process. There are, however, serious objections to the use of oil, for the super-heated ammonia vapors transform part of it into gas which passes through the oil trap into the condenser when it condenses and is carried with the liquid ammonia into the refrigerator coils. Here, the oil settles on the inner surface of the pipes and forms a thick soapy coat. This coat of oil acts as an insulator and prevents the cold ammonia from abstracting the heat from the pipes and their surroundings, and reduces the efficiency of the system. In some cases, this oil, together with scale and other foreign matter chokes the pipes entirely, and necessitates not only a large amount of disagreeable work re-

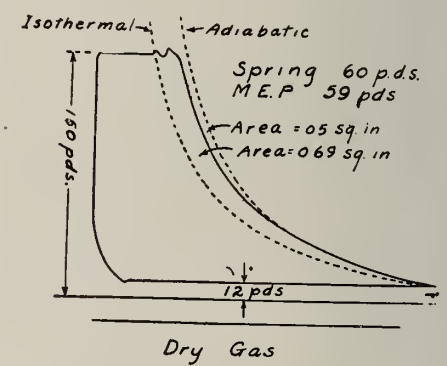


Fig. 2.

moving pipes but also the loss of valuable time when refrigeration may be in much demand.

Wet Compression.

In wet compression the heat of compression is absorbed by the re-evaporation of liquid ammonia and, thus, the mean effective pressure is raised by an amount due to the gas produced. The duty of the ammonia condenser is also increased to a slight extent. As a general thing, the compressor can be operated at a much higher speed with less loss of efficiency than can be done by the dry compression system. In the wet system, the ammonia gas is compressed in contact with its own liquid, that is, a small amount of ammonia liquid is injected into the compressor at the beginning of each stroke. The ammonia vapor is, therefore, kept saturated throughout the length of the stroke,

and the pressure and temperature of the mixture cannot rise above that of the liquid until the latter is evaporated.

The Linde System of Wet Compression.

In the Linde system of wet compression, the compressor is operated cool, without the necessity of any outside agent. The refrigerating system is so arranged that the liquid ammonia which passes through the pipes does not all form into gas, but small quantities of it are carried back again to the compressor, forming with the gas what is known as saturated gas. These small particles of liquid ammonia during the compression period form into a gas by the heat evolved, and in so doing absorb the superfluous heat that would otherwise be generated. In this way the compressor is kept cool; the gas, under ordinary running conditions, leaving the compressor at a temperature of about 125 degs. Fahr.

This method of keeping the cylinder cool has been found in actual practice to be highly satisfactory. It has also this advantage over the dry gas compression system, that the compressor can be run without the injection of very much oil. As before stated, the dry gas with its high temperature makes it necessary to inject oil into the compressor for the valves and piston. This is to a large extent dispensed with in the Linde system; the liquid ammonia having a certain amount of lubricating quality in this state that is lost when the liquid becomes a gas at a high temperature. The low temperature also is an advantage in that, together with an increase in temperature there is also an increase in pressure. This increases the mechanical energy necessary to perform the compression, therefore, a loss in power results. The increased temperature also requires additional space in the condenser, and more water to condense the ammonia gas to a liquid.

In wet compression there is a limit to the amount of liquid which is advisable to allow to come back to the compressor, for it must be borne in mind that the liquid used to saturate the gas for compression is not available for refrigerating, and has been attained through condensing. Too much liquid used in this way decreases the refrigerating efficiency of the system correspondingly.

Diagramatic Comparisons.

Figs. 1 and 2 are intended to show graphically the comparative efficiency of the wet gas cooling v. the water jacket system employed in dry gas machines. The initial volume and pressure and the terminal pressures are the same in both cases. In dry gas compression the curve necessarily follows for a considerable distance the adiabatic line. This happens for the reason that the gas coming into the cylinder from the expansion coils is at a temperature of 5 degs. Fahr., and no heat can be transmitted from it to the cooling water in the water jacket until the temperature of the gas has been raised above that of the water, which is probably about 60 degs. fahr.

In the saturated gas diagram, the unexpanded ammonia begins immediately to absorb the heat of compression. The compression curve at once leaves the adiabatic and approaches the isothermal line, making a diagram that is much smaller in area and which, therefore, requires less mechanical energy to complete compression. In these diagrams the efficiency of the cooling is for fig. 2, 54 per cent., and for fig. 1, about 70 per cent. Assuming that the diagrams are from an 18 x 30-inch double acting compressor running at 50 revolutions per minute, the effective h.p. required for the compression of the saturated gas would be 101.1 h.p., as against 113.7 h.p. for the dry gas machine; a gain of 10.2 per cent in favor of the wet system of operation.

CORRECTION.

DUE to an editorial oversight, the title of the article on page 68 of our March issue was made to read "The Refrigerating Plant at the Winnipeg Abattoir," instead of "The Refrigerating Plant at a Winnipeg Abattoir." The opening sentence of the text, however, indicated that the installation was a private enterprise.

A LARGE REFRIGERATING UNIT.

THE Wm. Neilson Co., Ltd., are making extensive improvements to their already large factory on Gladstone Ave., Toronto. The new machinery being installed includes one of the largest refrigerating units in the city. It is a 125 ton ammonia compressor supplied by the Creamery Package Manufacturing Co., of Chicago.

The machine is of exceptionally heavy construction; the frame, including cylinder, cross-head ways, main bearing, etc., being cast in one pieee which is not the usual practice in machines of this size. This casting weighs 42,000 lbs. and is said to be the largest casting ever put in a refrigeration machine. The frame is of identical design to that which the firm install in their 200 ton compressor, excepting that it is six inches shorter. The machine is being placed upon a double cement foundation; the idea being at some future date, to double the capacity of the unit by connecting a similar machine to the other end of the crank shaft.

The compressor is belt connected to a Can. General Electric Co. 175 h.p. a. c. motor, by a 38 inch double-ply leather belt over a 16 foot diameter, 42 inch face, cast iron split pulley. Between the two parts of the double foundation is a pit of sufficient depth to accommodate the pulley, the total weight of which is 29,000 lbs. The speed of the crank shaft is 65 r.p.m. when running at full capacity. The cylinder is 16 inch diameter by 36 inch stroke.

THAWING ICE-BOUND PIPES.

In the course of its good work, the Manchester Steam Users' Association is distributing information broadcast on kitchen boiler explosions. A kindred subject, the thawing of frozen water pipes, is of both engineering and domestic importance, and the Association's chief engineer, Mr. C. E. Stromeyer, has a little remedy of his own which will be of great value to pipes in distresss. It is based on the principle that strong brine eats it way into ice like an acid, and that the resulting diluted brine rises and makes room for the denser fluid. First close the main tap, and with a spanner uncrew the top of the valve of the frozen water pipe and remove the small valve. Ball taps to cisterns may have to be unscrewed altogether. Insert a few feet of one-eighth inch rubber or lead tubing into the pipe and pour concentrated brine into it through a small funnel. Replace the valve and cover, but leave the valve open, also open the main valve and wait. If the ice plug in the pipe is only one or two feet long it will have got eaten through in about an hour's time, if longer the above operation should be repeated several times. The brine is prepared by boiling an excess of salt in water, say half a pound per pint; it should if possible be used hot and renewed frequently.

MUST BUY IN CANADA.

The Canadian government will hereafter require all materials used for railways subsidized by parliament to be purchased in Canada. An understanding to that effect at present exists, but complaints have been made that it is frequently disregarded, especially in the west. A specific clause providing for the purchase of all material in Canada will in future be inserted in all subsidiary contracts.

L. W. Rundlett has been appointed Engineering Commissioner at Moose Jaw, on a salary of $6,000 a year.

THE READERS' POINT OF VIEW

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

INTERNAL COMBUSTION ENGINE.

By A. F. White.

E. D. H. query in a recent number of The Power House, as to why 4-cycle engines are built when the 2-cycle engine is so much more simple and cheaper to construct. The writer in answering this question, of course, assumes that E. D. H. refers to the small class of crank case compression engine and not to the positive scavenging 2-cycle engine as made in the larger sizes.

The reason why, up until now, the 4-cycle engine has had such a living practical application, compared with its twin brother, the 2-cycle, is chiefly owing to the inherent weakness of the latter in its inability to scavenge, or in other words, its inability to expel all the products of combustion out through the exhaust. These remaining products of combustion when mixed with a fresh charge of combustible fuel decrease the magnitude of the explosion and thereby reduce the efficiency.

Another important defect which has been proved by a number of tests on fuel consumption, also, on the analysis of the exhaust gases, is that a certain amount of the incoming mixture escapes through the exhaust port with the exhaust gases. This is due to the exhaust ports being open at the time of charging, and the great difficulty is proportioning and directing the flow of the entering gas and air at different ranges of power so as to displace the burnt gases without losing a part of those unburnt.

The 4-Cycle Action.

In the 4-cycle engine, the piston acts alternately as a pump and as an engine. As a pump, it draws in and compresses a combustible charge, and as an engine it uses the energy derived from the combustion of the charge and expels the products of combustion. It is, therefore, obvious that to obtain satisfactory results, the above functions must be accomplished and the following objects obtained: The getting of a combustible charge into the cylinder, its compression, the utilization of its combustion and the getting rid of the products of the latter.

The 2-Cycle Action.

In the action of the 2-cycle engine, the piston does nothing in the way of effecting a mechanical removal of the burnt gases, this being left entirely for the incoming charge. This is accomplished by the new charge expelling the exhaust gases through the exhaust when the port is wide open, and at different ranges of speed and adjustments of mixture. Quite a large percentage, therefore, of the new charge finds its way out by way of the exhaust, leaving a poor and insufficient charge (diluted with some of the products of combustion from the old exploded charge) to be compressed and ignited, thus creating the possible danger of a back fire.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

It is self-evident for these reasons that the 2-cycle engine is inferior to the 4-cycle engine from both fuel consumption and reliable starting standpoints. It is also altogether unsuitable for lower grades of fuel, such as producer gas. However, when economy is not a prime consideration, and the fuel is suitable, the 2-cycle engine may be regarded as a modification valuable from the point of view of more even turning movement, compactness, simplicity and minimum weight per horse-power. During the period from 1876 to 1890, while the Otto patents were protected, a great number of 2-cycle stationary engines were manufactured and after the lapse of these master patents in 1890, practically every maker took up the construction of 4-cycle engines. This offers emphatic testimony to the practical advantage of the 4-cycle engine, and there is every reason to believe that this type of engine is likely to remain unrivalled for small and moderate powers.

Large Gas Engines.

In very large gas engines it is necessary to obtain the greatest amount of power per volume of space and weight, and very powerful units are now being constructed on the 2-cycle system, but with these engines, a special scavenging and charging system is fitted in the form of separate pistons. This, of course, complicates the mechanism in some cases, even to a greater extent than does the 4-cycle gear.

The Diesel type oil engine, which is the subject of much discussion at the present time, is specially adapted to 2-cycle construction, owing to the fuel not being injected into the cylinder until the end of the stroke, at the firing point, thus preventing loss of fuel. The danger of pre-ignition and back-firing are also obviated. Quite a number of this type are now being constructed, and it is the writer's opinion that this form of engine will become standard practice in the near future.

AUTOMATIC OPERATION OF HYDRO-ELECTRIC PLANT.

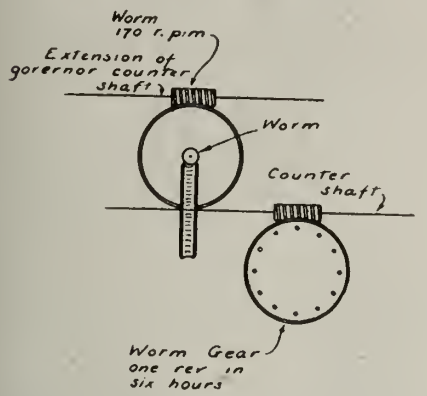
By W. A. P.

A RATHER ingenious device was constructed by the attendant employed to operate a miniature hydro-electric plant which supplied current to the buildings and grounds of a small summer institution.

A worm, which operated a train of worm gears and worms, was keyed on an extension of the shaft carrying the small governor pulley. The speed was reduced in this train from 170 r.p.m., the speed at which the first worm ran, to the remarkably slow speed of one revolution in six hours. The last gear in the train was this slow revolving link. About three-quarters of an inch from the outside of the rim of this gear, a series of twelve small holes was drilled, and a

pin made which, when inserted in any one of these holes, would at a given point in its revolution release a dog. This dog caused a small shelf to collapse and a weight resting on the shelf, had in consequence to be supported by a cotton rope tied to it and connected with a lever through a small pulley.

The sudden force thus imparted to the lever engaged a clutch which slid along a



Automatic Operation of Hydro-electric Plant.

revolving shaft on a feather key, and this in turn set in motion the gate closing mechanism. The gate when closed was prevented from further motion by a positive stop. The timing was extremely simple. There were twelve holes in the rim. One revolution occupied six hours, therefore, if the dog were released at a given moment, and the pin immediately inserted in the next hole it would be exactly one half hour before the dog were again released. The plant could, therefore, be automatically closed down at the end of any half hour period, up to six hours.

OLD STORY RE-TOLD.

S.S. Umbria Thrust Shaft Repair.

By Frank Walker.

AN unpleasant experience which caused some excitement in shipping circles occurred to the Cunard s.s. "Umbria," in December, 1892, while outward bound from Liverpool to New York. This vessel was at that time one of the crack "Atlantic greyhounds" and was with her sister ship, the "Etruria," among the last of the big single-screw boats engaged in the Western Ocean mail and passenger trade.

Break in Thrust Shaft Body.

On the second day after leaving Queenstown the thrust bearing commenced to heat badly and in spite of the closest attention, continued to such an extent that it was decided to stop and make a careful examination of the cause. When the thrust block was stripped and the horseshoes removed, a serious flaw was discovered, extending almost around the shaft between the third and fourth collars from the forward end. Probing the crack with feelers elicited the fact that it was of great depth, the shaft being practically broken in two. The latter, an open-hearth, mild steel forging, was a large one, even as shafts go nowadays, its length being a little more than 20 feet over all and its diameter 20 inches. It carried 15 thrust collars, each 36½ inches diameter by 2½ inches thick, spaced 6½ inches apart.

After mature consideration it was decided, in view of the great value of the ship and cargo, to refuse assistance, for the time being, and endeavor to effect, by means of her own mechanical staff, a sufficiently adequate repair to enable the vessel to return to port under her own steam. In this undertaking the engine room staff were entirely successful and seldom has a heavier or better repair job been done at sea.

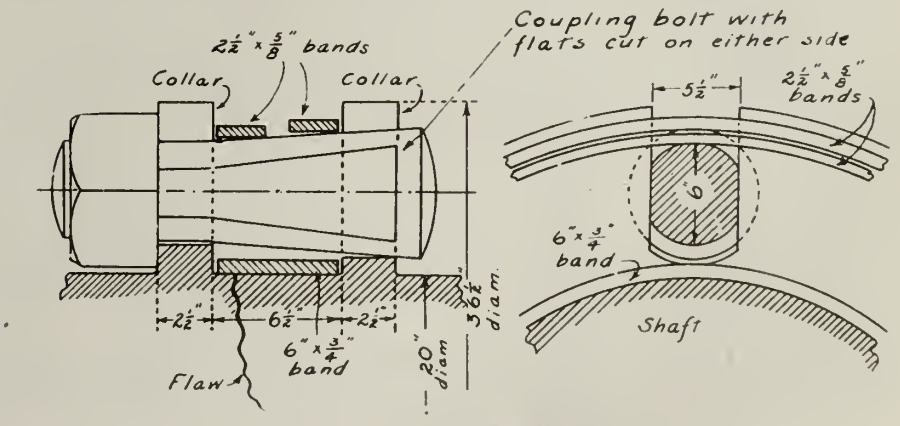
Scheme of Repair Adopted.

The repair methods adopted were as follows:—

The 4 forward horeshoes were discarded, and to bind the broken ends of the shaft together a band or yoke, bent from the stoutest material available, 6 x ¾ inches flat bar iron, was bolted in two halves snugly around the flaw. Four notches 5½ inches wide extending almost down to the shaft were cut in each of the collars on either side of the break—that is the third and fourth from the forward end. These notches were cut opposite and parallel to each other and spaced 90 degrees apart. Into each pair of notches, and acting as driving pins, spare coupling bolts 6 inches diameter by 18 inches long were fitted; parallel flats being chipped on the bolts in order that they might be fitted properly and take a good bearing. Around the four bolts and binding them securely in the notches a second pair of bands bent from 2½ x ⅝ inch flat bar iron were snugly bolted. Under the shaft in the space between the first and second collars a stout chain sling was passed, the ends of which were brought up together and secured to a rigging screw suspended from an eyebolt in the roof of the tunnel mouth. This prevented any downward thrust or sag of the broken shaft.

The accompanying sketch explains the details and it will be readily understood that the amount of work entailed was enormous. The eight notches 5½ x 2½ x 8 inches deep, had to be cut entirely by hand—ratchet, brace and drill, hammer and chisel—as also had the flats on the coupling bolts; but after 64 hours of continuous labor—it is on record that men dropped exhausted with the tools in their hands—the repairs were completed and so thorough was the job that, after a careful trial, the captain decided not to turn back but to continue the voyage to New York at reduced speed. The Umbria arrived there safely, seven days overdue, but in time, if I remember rightly, to land her passengers for Christmas day.

A survey of the vessel was made in New York, but the repairs were found so satisfactory that she was allowed to return to Liverpool in ballast, which she did at half speed. Events like this prove what our sea-going engineers can accomplish when they are "up against it."



S.S. Umbria, Thrust Shaft Repair.

INTERNAL COMBUSTION ENGINES.

By A. F. White.

FOLLOWING the recent article on the governing of gas engines, this paper deals with the various methods adopted in starting them.

The starting of an internal combustion engine is an important function, and while, having no effect on the actual working of the unit, it contributes largely to the amount of satisfaction obtainable, and has no doubt been the cause of more or less complete failure in many plants otherwise well equipped. Of course, there may have been lack of discrimination in such cases, yet, the failure is invariably charged to the gas

power proposition as a whole. Again, no matter how economical a plant is in fuel consumption it cannot be considered economical if it is not absolutely reliable to start at any moment.

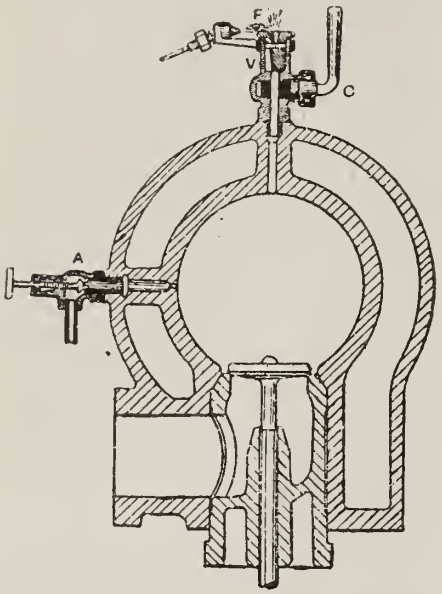


Fig. 1.

A gas engine will not start under load as does a steam engine, owing to the fuel not being delivered in the form of pressure, therefore, it is necessary to get it in motion by means of some special source of power in order to have it turn rapidly enough to take up its normal cycle of operations. Usually this power is not adequate to obtain the required speed when connected to any considerable load, in which case it is always preferable to throw the load completely off until the engine gets under way. This may be done by means of a clutch or tight and loose pulleys. In the case of an electric generator, such apparatus is not necessary, as the resistance of the belt and generator unexcited is negligible.

Methods of Starting.

There are several methods of starting. If the engine is small—not exceeding about 15 H.P.—it may be disconnected from its load and pulled around by hand until an explosive mixture is admitted and ignited, but as it is difficult to pull the engine over the compression dead centre, it is customary to ease the compression. This is usually done by bringing an extra cam into action on the exhaust, which holds the valve of the latter open for a considerable part of the compression stroke. A part of the charge which has been taken into the cylinder on the induction stroke is expelled out through the exhaust. There is, then, a smaller volume left in the cylinder to be compressed, consequently the engine overcomes the dead centre more easily. After a few explosions and, when the engine comes up to speed, the relief compression may be cut out and the compression changed to its maximum. With large engines, it is impractical to start by pulling the flywheel around by hand, and sufficiently expressive language to meet the circumstance usually fails at 10 H.P.. and many of us have often been at a loss for words at even smaller powers on a hot day. However, it is necessary for every engine above 15 H.P. to be fitted with some special device for starting other than by brute force.

Lanchester Starting Devices.

There are a number of ingenious starting arrangements on the market, and a brief description of some of the most noteworthy may be interesting. Fig. 1 is a general view of the Lanchester starter fitted to an engine. This appliance is the simplest form of starter ever brought out, yet its scope is limited, being only suitable on engines using city or natural gas. Its action is as follows: When ready for starting, the engine is barred around to the commencement of its working stroke: the valve (C) is opened and gas turned on at (A). The stream of gas and air passes out of the cylinder through the cock and ignites, when rich enough in gas, at the naked flame shown at (F). The mixture burns at the orifice, at first, with a pale blue flame which becomes deeper in color as it becomes richer. When the flame burns

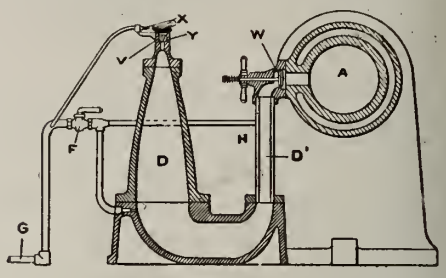


Fig. 2.

with a roaring noise, the valve (A) should be closed. The flame will now strike back into the cylinder and ignite the entire column of the mixture in the combustion chamber. The check valve (V) closes with the pressure, preventing the escape of gasses from the orifice at top of valve (C), and the pressure thus obtained is sufficient to move the piston forward and store up sufficient energy in the flywheels to form a complete cycle

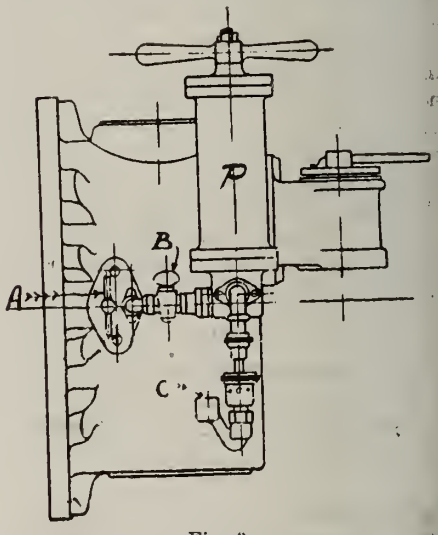


Fig. 3.

of operations of the crankshaft and piston, so that a charge of mixture will be drawn in and exploded, and the engine gradually brought up to its normal speed and power. By this method of starting, the mixture is ignited at atmospheric

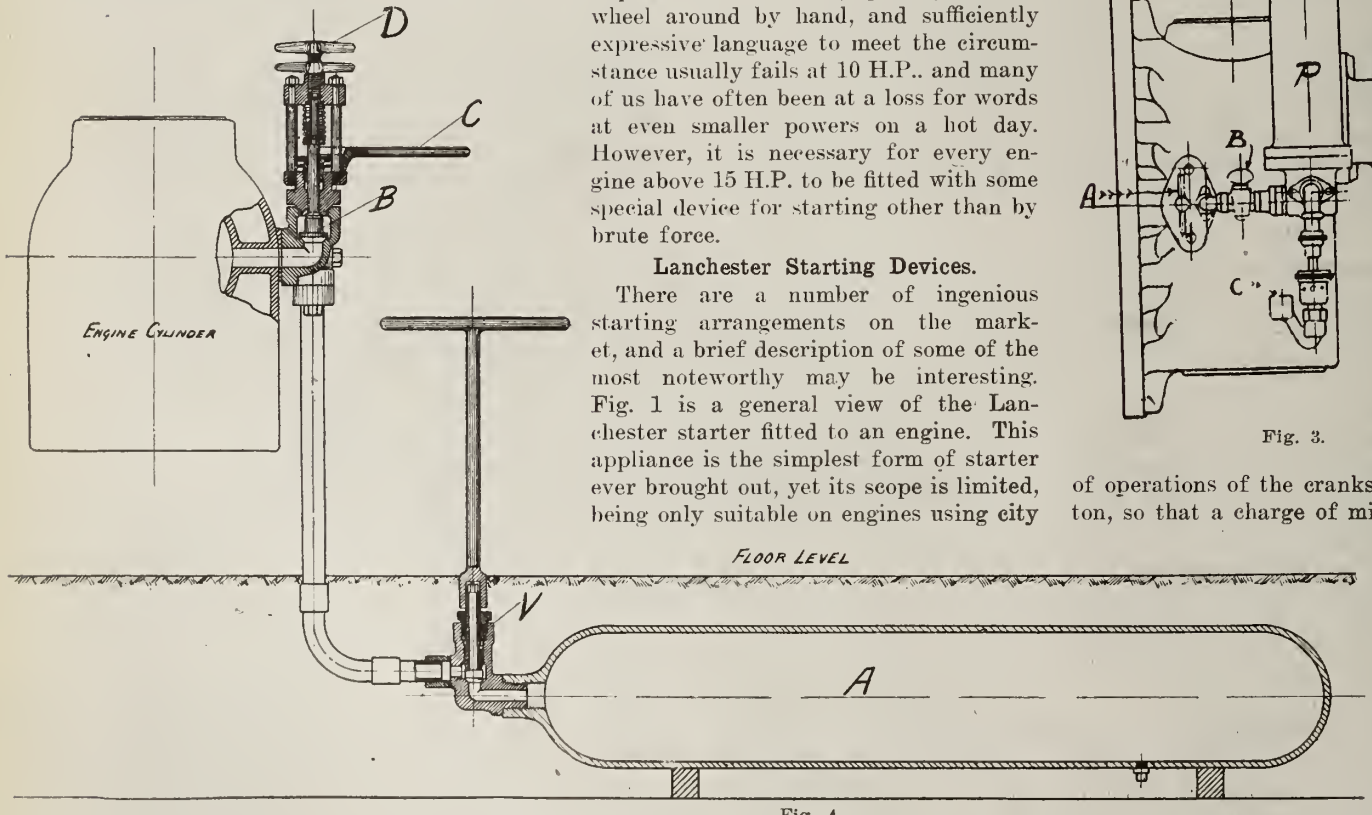


Fig. 4.

pressure or without compression; hence the impulse of the starting stroke is limited as the highest initial pressure will not usually exceed 80 pounds per sq. in.

Clerk-Lanchester Starting Machine.

In order to increase the starting pressure, Mr. Dugald Clerk was the first to apply the apparatus shown diagramatically in Fig. 2, which is known as the Clerk-Lanchester pressure starter. It is, as will be seen, a combination using the Lanchester automatic valve and igniting arrangement. The preparation for starting is precisely the same as with the Lanchester, the engine being barred around to the commencement of its working stroke, the valve (F) opened, the gas turned on, and the gas jet

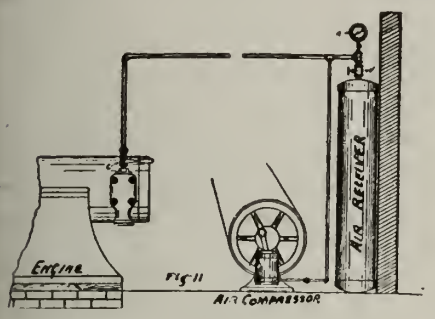


Fig. 6.

lighted to ignite the mixture as it issues from the orifice (Y). The action of the starter is as follows:—The cylinder (A) and chamber (D) are filled at atmospheric pressure with an explosive mixture which is ignited at the orifice (X), and as the gas burns downwards, it expands, driving a large portion of the mixture still unburnt through the pipe (D) into the cylinder at the spring loaded valve (W). In this way the pressure of the mixture in the cylinder is considerably raised before the flame reaches it, when, therefore, the mixture in the cylinder ignites, it explodes violently, developing a maximum pressure of 190 pounds per sq. inch, which is sufficient to start up the engine even against considerable resistance of load.

Producer Gas Engine Starter.

These two forms of starter are unsuitable for producer gas owing to the difficulty and uncertainty of obtaining the correct mixture. The form of starter shown at Fig. 3 is often used, and the method of operating is as follows:—The crank is placed a little above the dead centre on the power stroke and a small quantity af gasoline is poured into the cup (C). The gasoline is pumped, together with a quantity of air to form the explosive mixture, into the cylinder by the hand pump (P). When a sufficient pressure is exerted on the piston to move it forward a little, the electrié ignition is brought into play and the charge ignited, thus driving the piston outward and developing sufficient speed to form a complete cycle of strokes, after which the engine will pick up and explode its own charges of mixture. The gasoline starter fills the bill, and gives somewhat satisfactory service on moderate sized engines, but it is not by any means as reliable and simple as a good compressed air starter. The latter system is now used exclusively for engines above or about 50 H.P.

Compressed Air Starter.

With the compressed air system of starting, the air is admitted to the cylinder at a pressure of about 100 pounds per sq. in. by means of a valve. It acts on the piston just as steam does in a steam engine. This method is especially desirable in an engine having several cylinders, one of the latter being used as a compressed air cylinder to run the engine until the others take up their normal cycle of operations, when the compressed air is shut off and the first cylinder comes into normal action. If the engine has only one cylinder it can be brought up to a good speed by the admission of one charge of compressed air, and providing the pressure be around 100 pounds, the engine will continue to revolve until an explosive mixture is taken in and exploded.

An arrangement for starting by air and using the engine as its own compressor is shown at Fig. 4. This arrangement consists of a container (A) and a special spring loaded valve (B) which is operated as a check valve when the engine is compressing air and by the handle (C) when starting the engine. The principle on which this type of starting apparatus works is that on stopping the engine at the end of a run the energy stored in the flywheel is used to drive the engine as a pump to provide the compressed air for the next start. To effect this, the gas

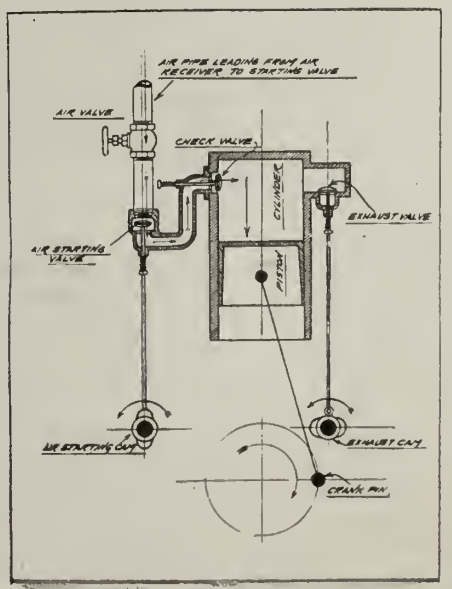


Fig. 5.

is shut off and air only is drawn in at the suction stroke. This is compressed into the container through the special combined check vale (B). When the engine has slowed down to such a point that it is nearly stopping, the valve (B) is screwed down by the hand screw (D) the gas turned on, and the engine again brought up to speed. The same process is repeated until the container shows a pressure of about 110 pounds, when the handle (D) is screwed down tightly and the air bottled up ready for the next start-up.

To start up it is only necessary to bar the engine around until the crank is a little above the dead centre on the firing stroke, set the gas to its working point at the gas cock, open up valve (V) on the container (A) and the hand screw (D). On opening the valve (B) by the handle (C) the air will enter the cylinder and exert sufficient pressure on the piston to start up the engine at considerable speed. The valve (B) must, however, be closed just before the piston reaches the end of its stroke or a considerable amount of the compressed air will be lost through the exhaust valve which commences to open at a point before the end of the power stroke. On some engines the starter valve is operated mechanically as shown at Fig. 5. This is preferable to the hand operated starting valve as it cuts off the air supply just at the proper moment and does not call for special care on the part of the attendant.

With large engines, it is necessary to install an independent driven air compressor outfit, as with the arrangement just described, there is usually about four available charges and should the engine fail to start at these four attempts and all the air be used up, it would be impossible to get a large engine started, unless some other auxiliary form of starter be fitted. It is, therefore, essential that a complete independent air starting equipment as shown at Fig. 6 be supplied on an installation above 50 h.p. The compression may be run with a small gasoline engine, electric motor or other power available.

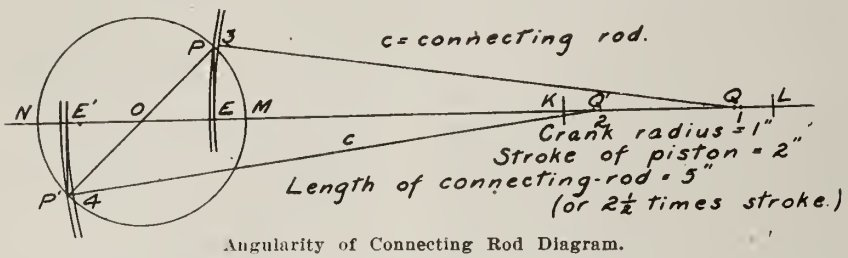
EFFECT OF ANGULARITY OF CONNECTING ROD.

By Chas. J. Mason.

EXPLANATION of why the distance QL is greater than the distance Q'K, as seen in the figure which accompanies this explanation is required. First, as to the construction of the figure, then the explanation.

At the point 0 as centre on the horizontal line, describe a circle with a radius of 1 inch. This radius is chosen as a matter of convenience, as any other

figure would serve as well. The circle represents the path of the crankpin of an engine. Draw the line PP¹ through the centre O, and at any convenient angle to the horizontal line as shown. PO and P¹O reperesent the crank in two different positions. The diameter of the circle, which is 2 inches, also represents and equals the stroke of the piston. Now, make choice of a connecting-rod, which shall be 2½ times as long as the strokes, or $2\frac{1}{2} \times 2 = 5$ inches. This figure also is chosen as a mater of convenience, as any other (within reason, of course) would serve as well.



Angularity of Connecting Rod Diagram.

From the point M, which represents the head end centre (referring to the position of the crank), measure off 5 inches on the horizontal line to the right. This locates the point L. The distance ML equals the length of the connecting-rod. In the same manner measure off 5 inches from the point N (which represents the crank on centre) on the horizontal line to the right. This locates the point K. The distance KL is the same as NM — 2 inches, and represents the stroke of the crosshead, which may also represent the stroke of the piston, because both crosshead and piston move through the same number of inches distance.

When the crankpin is on the crank end centre at N, the crosshead wristpin is at K, and when the crankpin is at the head end centre at M, the crosshead wristpin is at L. If it were not for the effect of angularity of connecting-rod, the corresponding piston positions for the crank positions PO and P¹O would be E and E¹, as found by projecting the point P downward to the horizontal centre line, and the point P¹ upward to it. Both lines PE and P¹E¹ are at right angles to the horizontal centre line. Measurements will prove that the distance NE¹ equals the distance ME.

Measure off and locate from the point L, the distance L1; and from the point K the distance K2; these distances to be the same as NE¹ and ME. The points 1 and 2 represent where the crosshead wristpin would be, corresponding to the crankpin positions P and P¹, if angularity of connecting-rod did not affect the case. By drawing in the connecting-rod as shown in the figure, using the given 5 inches length, it will be seen that instead of the crosshead wristpin being at points 1 and 2, as it should be in order to equalize matters, it will be at Q and Q¹, respectively; that is, the rod has been drawn away from point 1 to point Q in order that the other end connects to the crank P. Imagine the rod to be disconnected at P and allowed to swing to the horizontal centre line, as shown by the arc; then the distance between where the arc intersects the horizontal line and the point E will equal the distance Q1. If the crosshead pin had remained at point 1 instead of having been moved to Q, then the crank would have to be brought to the point where the arc intersects the crankpin circle at point 3.

A careful study of the figure and measurements of same will show that the crosshead wristpin (which, to remind, represents the piston) must move from point 1 to point Q, so that the other end of the rod will meet the crank. While it is true that the distance E1 is equal to the length of the connecting-rod, so is the distance 3—1, but as the crank is at P, the rod must be drawn along to meet it, and as the length of the rod remains the same, the other end is at point Q. The same reasoning applies to the crank position P¹ and distances KQ¹ and Q¹2, so there is no need to repeat it in the explanation.

After the reader once arrives at an understanding that the distances Q1 and Q¹2 must exist as explained, he will have no difficulty in seeing that the end of the rod as represented by the points Q and Q¹, have been moved from the points 1 and 2 respectively in a direction from the end of the stroke L, and towards the other end of the stroke K; that is, both positions call for a moving of the rod in the same direction, so that, of a necessity, the distance L1 is increased to LQ and the distance K2 must be decreased to KQ¹. It is to be remembered that K2 and L1 are exactly equal, and it was known at the start that QL and KQ¹ are not equal. From the foregoing explanation, and by careful measurement it will be seen that the difference between QL and KQ¹ is the distance Q¹2 plus distance Q1.

The longer the connecting-rod or the shorter the crank, the less will be the distances Q¹2 and Q1. The shorter the rod or longer the crank with the same rod, the greater will become the distances Q¹2 and Q1.

If the reader will carefully study the diagram in connection with what has just been stated, and at the same time have a pair of dividers and a scale at hand to measure and transfer measurements, he cannot but see why the distances referred to at the beginning of the explanation are as they are. A thorough understanding of the foregoing will require more than one reading of it, and more than one inspection of the illustrative figure which accompanies it.

Steam Heating and Isolated Power Plant Cost

American Engine Co. Report.

There is here discussed a variety of conditions likely to be met in the realm of Isolated Plant Power with Steam Heating as its basis. Climatic conditions in Canada call for a more or less protracted season during which steam heating is necessary and in the development of our manufactures, a large degree of isolation often becomes necessary, therefore, the typical examples and figures given, relative to costs involved, will be found interesting and valuable.

WHERE steam heating is required, electric power may be generated as a by-product of the heating plant, at a cost of less than 2 cents per kilowatt-hour in the majority of cases. The reasons for this low cost of generation may be summarized as follows:

(1)—The fixed costs, which go to make up a large share of the cost of power, are chargeable only against the additional investment for the plant by which electric power is generated, over and above the investment for the low pressure steam heating plant.

(2) — The coal cost chargeable against electric power is reduced, during those periods when the exhaust steam is used for heating, to a small percentage of the coal consumed, representing that part of the heat in the steam which is lost between the high pressure boiler and the heating system.

(3)—The labor charge comprises only the additional labor required, as compared to a low pressure heating plant. Furthermore, by reason of the additional labor, which is of a higher grade, greater

economy is obtained in fuel consumption, amounting to a saving in coal of 5 to 15 per cent., which in a plant of fair size will pay the wages of an engineer.

(4)—While the charges for oil, waste, repairs and miscellaneous items are incurred entirely through the installation of the engine and generator, they amount to a small proportion of the total expense.

Every isolated plant with exhaust steam heating must be considered as a separate problem, because of the wide variation in load, cost of coal, water, labor, etc. The following case, which may be presented as a typical one, will serve to outline the calculation whereby the cost of power may be determined, and, secondly, to indicate the influence on the cost per kilowatt-hour of the three most important factors—the fixed charges, the price of coal and the amount of exhaust steam used for heating.

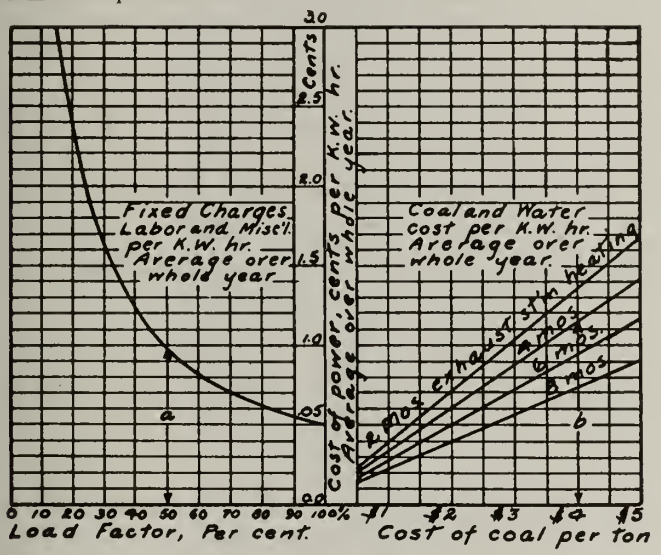

Cents
Cost of power, cents per K.W. hr. Average over whole year.
Fixed Charges, Labor and Misc'l. per K.W. hr. Average over whole year.
Coal and Water cost per K.W. hr. Average over whole year.
Load Factor, Per cent.
Cost of coal per ton

Fig. 2—Average yearly costs of coal, water and fixed charges per K.W. hour.

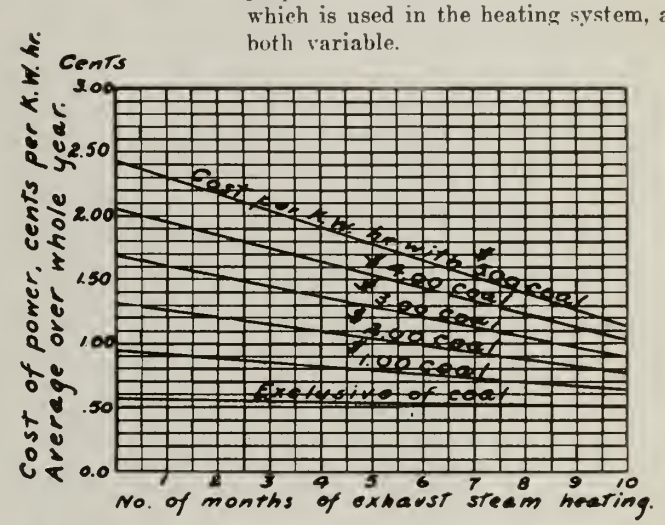


Fig. 1—Cost of power per K.W. hour for various prices of coal and periods of heating with exhaust steam.

Fixed Charges.

An industrial plant operating 3,000 hours per year, with an average load of 200 K.W., will be assumed. Two 100-K.W. and one 50-K.W. engine-driven dynamos, installed with suitable piping and appurtenances, will cost about $11,000.

Two 200-H.P. boilers would be required; however, the total cost of these boilers would not be chargeable against power, since boilers would also be required for the low pressure heating plant. The cost per horse-power of low pressure boilers, grates, stack, etc., is about the same as a similar high-pressure equipment. Because heat is lost and consumed between the high pressure boiler and the heating system, a somewhat greater boiler capacity must be installed when power is to be generated, and as the exhaust from an engine contains from 80 to 90 per cent. of the heat given to it by the boiler, an increase of the latter's capacity of 25 per cent. over the low pressure equipment will take care of this item and also any additional cost of a high pressure boiler as compared to a low pressure equipment.

At $18.75 per horsepower, including boiler, grates, stack setting, piping and labor of installation, the additional boiler cost is $1,500. This additional boiler cost will vary; in fact, in plants already equipped with low pressure boilers, it will pay to replace the equipment with high pressure boilers and utilize exhaust steam for heating.

The two largest items of additional first cost, totalling $12,500, have been considered. It might, of course, be profitable to install other apparatus in a plant of this character, as for instance a feed-water heater, but as that piece of apparatus should pay for itself out of the coal saved, it will not be considered under the items of additional first cost.

Of the total additional cost of $12,500, a certain fixed percentage must be charged annually against the cost of power. The fixed charge may be set down as follows: Interest, 5 per cent.; depreciation at 5 per cent.; insurance, real estate, upkeep, obsolescence, 5 per cent.; total, 15 per cent., or $1,875, which is the fixed charge per year against the additional investment for apparatus to generate power as a by-product of the heating system. The cost for additional labor may be taken as one man at $800 per year, while repairs, oil, waste, packing, etc., may be set down as $250, making a total of $1,050.

Coal.

The coal chargeable against power comprises the coal equivalent of the heat lost between the high pressure boiler and the heating system when the heating season is in use. When no heating is being done, all of the coal burned under the boiler is chargeable against power. The cost for coal will, therefore, depend upon (a) the steam consumption of the engines per K.W.-hour; (b) the efficiency of the boiler; (c) the cost of coal; (d) the percentage of the total amount of steam generated which is used by the heating system.

(a)—The steam consumption of an American-Ball angle compound engine is 26 lb. per horsepower-hour (non-condensing), or 40 lbs. per kilowatt-hour. In order to be on the safe side and to take care of the effect of reduced and fluctuating loads on steam consumption, assume 60 lbs. of steam per kilowatt-hour.

(b)—Assume a boiler efficiency of 60 per cent., or about 8 lbs. of steam per pound of coal.

(c and d)—The cost of coal and the proportion of the total steam generated which is used in the heating system, are both variable.

In the Table given herewith, the cost of coal ranges from $1 to $5. The amount of steam used in the heating system is taken care of by considering it as the number of months of the year when all the exhaust steam is used for heating.

Strictly speaking, at the beginning and end of the heating season, there are periods when only a moderate amount of heating is required and only a portion of the steam exhausted by the engines is utilized. This decrease in heating load may be taken care of by assuming a shorter heating season. For example, suppose that for four months during the winter, all the exhaust steam was used in the heating season and that for one and a half months before and after this season the amount of steam used in the heating system varied from zero to full capacity. It would then be quite accurate to assume that the heating season of 7 months would be equivalent so far as amount

of steam used for heating, to a season of 5½ months in which the heating load was always equivalent to the full exhaust of the engine.

Water.

An average price for water is 10 cents per 1,000 gallons. During the heating season it is reckoned that only 80 per cent. of the water is returned to the boiler. During other periods all the water is lost. It should be noted that it is assumed that in a low pressure heating system all the water is returned to the boiler, that is, there is no loss, and in setting down the additional cost for water when power is produced as a by-product, it is assumed that condensation in high pressure steam piping, condensation in the engine, etc., results in a 20 per cent. loss during the heating season and when the steam is exhausted to atmosphere, a 100 per cent. loss. With the fixed costs, labor cost, already given, and calculating the coal and water charges for given conditions, the table and charts shown were obtained. The following example will serve to explain in detail the method of obtaining these figures.

Example.—Assume the heating season equivalent to six months of full load steam heating, during which all the exhaust is used. During this period the coal chargeable against power is the equivalent of the steam and heat lost between the high pressure boiler and the heating system. Assume, also, that 20 per cent. of the heat of the steam is lost in this manner. The other factors entering into the coal cost have already been given—load 200 K.W.; steam consumption 60 lbs. of steam per K.W.-hour; coal consumption of 1 lb. of coal per 8 lb. of steam, and hours per year, 3,000. With coal at $4.00 per ton, the cost of coal during the 6 months heating period is $900.

The part of the year when there is no exhaust steam heating, and those parts of the year when only part of the exhaust steam is used for heating, are equivalent to six months of straight non-condensing operation. The cost of coal is therefore $4.500. To this coal cost must be added the cost for water at 10 cents per 1,000 gallons. During the heating season, the heating sytem returns 80 per cent. of the boiler feed and the cost for water is $43.20.

COST OF POWER IN CENTS PER K.W.-HR. IN A TYPICAL ISOLATED PLANT; AVERAGE LOAD, 200 K.W.

Months of Exhaust Steam Heating	Price of Coal, Dollars Per Ton					
	$0	$1	$2	$3	$4	$5
2	.550	.880	1.200	1.525	1.850	2.175
4	.540	.820	1.090	1.365	1.640	1.915
6	.531	.755	.983	1.205	1.431	1.656
8	.521	.700	.871	1.046	1.221	1.396

For the other six months the cost for water is $216.

We may now set down the total charges for generating power at the rate of 200 K.W. for 3,000 hours a year, as follows:

Fixed charges	$1,875 00
Labor, oil and misc.	1,050 00
Coal	4,500 00
	900 00
Water	216 00
	43 00
Total	$8,584 00

During the year there is developed 3,000×200=600,000 K.W.-hours, giving a cost per K.W.-hour of $8,584÷500,000 =1.431 cents per K.W. hour. In the same manner it is found that when the heating season is equivalent to only two months of full-load heating, the cost per K.W.-hour is 1.85 cents. For the same conditions when the price of coal is $5.00 instead of $4.00, the cost per K.W.-hour is 2.175 cents, and in this way the table shown was compiled.

Charts.

From these data the charts of Figs. 1 and 2 were prepared. In Fig. 1 the cost of power in cents per K.W.-hour (average over the whole year) is plotted against the number of months that exhaust steam is used for heating, each line representing a different price of coal. With this chart in hand, we can study the influence of coal cost, length of heating periods, the influence of first cost, and also of percentage of that cost which should be charged off per year in order to take care of interest, depreciation, etc.

The chart may also be used to consider the cost of power in a plant where a low pressure boiler is already installed and must be replaced. The additional first cost of the high pressure boiler over and above the low pressure boiler, taking into account the fact that a boiler of higher capacity would be required, was assumed at $1,500. Assume that an entire new boiler would be needed costing $7,500. This would increase the additional first cost of the plant by $6,000 and the additional yearly charges by $900, making the total fixed charge $2,775. For 600,000 K.W.-hours per year, this would increase the fixed charge per K.W.-hour from 0.312 cent to 0.462 cent. The influence of this additional charge of 0.15 cent upon the cost of power with $4 coal, and when three months' exhaust steam heating is used, is therefore an increase from 1.75 cents to 1.90 cents per K.W. hour.

In the chart Fig. 2, the cost per K.W.-hour is plotted against the cost of coal in dollars per ton, and each line represents the cost for different lengths of heating periods. This chart is useful for investigating the effect of the price of coal and also the comparative effect of length of heating season and price of coal. For instance, the cost per K.W.-hour is practically the same, for an eight months' solid heating season with $4 coal, as it is with a two months' heating season with $2 coal. On reference to this chart, it will be noted that the costs exclusive of coal and water are considered separately—being plotted against load factor.

A load of 200 K.W. for 3,000 hours per year is considered as 100 per cent. load factor (although the plant capacity is 250 K.W.), At 100 per cent. the fixed charges, labor, etc., per K.W.-hour are 0.488 cent. Similarly at 50 per cent. load factor the cost per K.W.-hour exclusive of coal and water is 0.976 cent. By similar calculations, the complete curve is plotted, which may be used in connection with the curves at the right in order to study the cost of power under various conditions. Suppose, for instance, that the load factor is 50 per cent., then the ordinate a=0.98 cent= fixed charges, labor, etc.; if the coal cost is $4 a ton and the number of months of exhaust steam heating is 4, then the coal and water cost per K.W.-hour is given by b as 1.17 cents and the total cost of power per K.W.-hour is a×b= 2.15 cents.—From a report by the American Engine Co., Bound Brook, N. J., in Industrial Engineering.

STEEL WORKS MUST SMOKE.

In an address before the Sheffield Electro-Metallurgical Society Prof. J. O. Arnold took occasion to censure the smoke-abatement movement and to point out that without smoke, steel is impossible. So far as health is concerned, he said, the most mischief is caused by the household smoke, yet it is usually ignored by the smoke inspectors. Strange as it may seem, some medical men have recently taken to recommending the smoky parts of Sheffield for sufferers from asthma. Prof. Arnold asserts that in steel metallurgy, smoke is absolutely necessary. Any operation that removes the carbon will produce poor steel. If a smokeless flame is used, all the carbon is burnt out and the surface of the steel is made rotten. Most municipal authorities realize that smoke is essential to the manufacture of good steel and exempt metallurgical furnaces, but the question of mixed stacks is continually coming up to the annoyance of manufacturers.

DEVELOPED WATER-POWERS.

As a result of investigations undertaken by the Commission of Conservation, it has been ascertained that there are 1,016,521 horsepower developed from waterpower in Canada.

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Record of Gas Power Developments During the Year 1911

By Robert H. Fernald

The subject matter of this article constituted the annual address of the chairman of the gas power section of the American Society of Mechanical Engineers. The author, who is professor of mechanical engineering in the Case School, Cleveland, Ohio, indicates what is being achieved in the steam, oil and gas sections of the field of power generation, and gives us expectation of early future possibilities of efficiency and economy being realized, especially in the two latter directions.

LARGE GAS ENGINE UNITS.

THE development of large gas engine units has gone steadily forward for the past decade. The first unit of this class was that exhibited by The John Cockerill Co. at the Paris Exposition in 1900. This was an engine of 600 h.p. rating. At the present time, 1,500 h.p. in each cylinder of the 4-stroke cycle type and 2,000 h.p. in each cylinder of the two-stroke cycle engine are reported as one of the exhibits at the recent exposition at Brussels, which means units of 8,000 h.p. of the twin-tandem double-acting type. It is understood that at least one company is prepared to install gas engine plants of large power capacity at a cost not exceeding and in some instances less than that of corresponding steam turbine equipments.

The Diesel Engine.

Although the steam turbine has superseded the reciprocating steam engine for electrical development in central station work, and will probably hold the field for some time to come, it is interesting to note that the Diesel engine, owing to its great success in small station work, is looked upon seriously as a possible rival to the former within a short time.

In a paper recently presented before the Municipal Electrical Association at Brighton, England, the relative cost of a 10,000 K.W. installation of steam turbines, gas producers and engines, and Diesel engines was discussed at length. The author proposed to use seven sets each of 1450 K.W. capacity, and his figures of operating expense, etc., are decidedly in favor of the Diesel engine equipment. Attention was also called to the very economical use of these engines as a substitute for substation converting machinery.

In this connection it is interesting to note their development in point of size. Engines of a few hundred horsepower have become European practice. In Swiss electric stations, Diesel engine units of 2,000 h.p. are now in use, and one writer on the subject states that the development of the large-sized Diesel engine has been so successful that it will not be long before 1,000 h.p. developed in one cylinder will be thought nothing extraordinary. One company of world-wide reputation is at present considering more than 2,000 h.p. in the single cylinder of Diesel engines. It is stated that engines of this type with four cylinders developing 1,000 h.p. each can be made as light as the corresponding triple-expansion steam engine. The weight of Diesel engines compares favorably with that of the corresponding turbines and boilers. It is understood that a 1,000 h.p. installation of this type weighed only 187 lbs. per h.p. as compared with 180 lbs. for a steam turbine and boiler installation.

Crude Oil Engines.

The crude oil engine is now definitely under consideration for all types of marine craft. For small vessels the advantage lies in the safety afforded by the use of crude oil as compared with lighter oils. The crude oil engine is being used by many of the principal navies of the world for submarine boats, and designs are already under way for comparatively large engines for torpedo boats and similar craft.

A few months since, the "Vulcanus," a vessel of 1,900 tons displacement, 196 ft. long, equipped with 6-cylinder 4-cycle single-acting reversible Diesel engines, was put in regular service between Holland and Borneo. This engine is about 500 b.h.p. capacity at 180 r.p.m. The fuel is a crude oil from Borneo and the quoted guarantees are 0.42 lb. per b.h.p.-hour at full speed; 0.44 lb. at three-quarters speed; and 0.5 lb. at half speed. In a recent trip the "Vulcanus" covered 3,312 miles in 19 days and 3 hours. The average speed varied from 6.86 knots to 7.80. It is understood that the average consumption for this ship amounts to 1 ton of fuel oil per 100 knots.

The most recent development in the oil engine field is that of the Junkers marine oil engine. The engines of this type used in the freight vessels of the Hamburg-American Line are of the twin-tandem type of 1,600 total shaft h.p. each. They operate on the 2-cylinder principle, and through the introduction of two pistons into each cylinder double action is secured. The British Admiralty proposes to try out side by side in a twin-screw cruiser, a steam engine and a Diesel engine of 6,000 h.p. rating. A destroyer recently ordered by the British Admiralty will have on each shaft a steam turbine and a Diesel engine, operating the turbines when high speeds are required, but under cruising conditions, when the speeds are low, owing to the poor economy of the steam turbines, using the Diesel engines.

With the introduction of these engines the discomforts of the stoke-hole will be greatly reduced, the amount of labor required will be less than under present marine conditions, and the character of labor much improved. The fuel needed approximates a third of that required for the steam engine, thus greatly increasing the radius of action if the same weight of fuel be carried. Boilers can be done away with and their space utilized for carrying cargo. It is reported for a freight vessel of 2,700 tons that a saving of over $19 per day was made by using oil at approximately $11 per ton, instead of coal at about $3 per ton.

Tar as a Fuel for Diesel Engines.

Tar oil has become more or less common as a fuel in Diesel engines of 600 or 800 h.p. rating, and it is understood that it is used in at least one engine of 4,000 h.p. rating. Recent experiments indicate that both thin gas-retort tar and thick coke-oven tar can be used in a similar manner by injecting into the cylinder a small percentage of light oil to assist in igniting the tar. It is claimed that a wide range of tars can be used in this manner without producing smoke or appreciable residue. In tests at the Koerting works about 2 per cent. of the ignition oil was used at full load and about 13 per cent. at half load. Reports indicate that an order has been placed for 600 h.p. Diesel engine to operate on raw tar.

Internal Combustion Engine Locomotives.

Locomotives using internal-combustion engines and operating on the standard gauge track have recently been put into service. The range of fuel for these engines covers gasoline, benzol, alcohol and petroleum. The Prussian State Railways are reported to be operating a 1,000 h.p. locomotive using a Diesel engine as motive power.

The Gas Turbine.

Results are soon to be expected from the more recent investigations and tests

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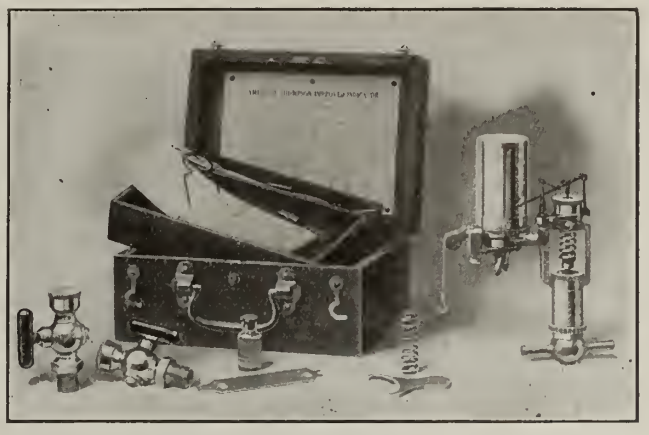

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relating to gas turbines. It is believed that some of the types are based on correct principles, and that after a rotary air compressor of satisfactory design has been secured, rapid progress in the development of this prime mover may be expected.

The Humphrey Pump.

This internal-combustion pump has been before the gas power public for two or three years past. A 1,000 h.p. pump occupies about the same space as the tandem double-acting gas engine of the same power. According to the inventor, the cycle of this pump, with a compression pressure of 11 atmospheres absolute, has a theoretical thermal efficiency of 52.5 per cent., whereas that of the Otto cycle is only 40 per cent. when all corrections for varying specific heats are allowed for. With very moderate compression, under 50 lbs., an actual thermal efficiency of 23 per cent. has been obtained on a 4-cycle Humphrey pump. This corresponds to 0.95 lb. of anthracite per hydraulic horsepower hour, and was obtained on a lift of only 35 feet.

Utilization of the Waste Heat of Gas Engines.

Various methods of utilizing the waste heat of the gas engine exhaust have been attempted from time to time and the demand for such devices for heating buildings has been considerable. Several schemes for accomplishing this result are now commercially in use, but according to recent opinions the most efficient method of utilizing the exhaust is through a combination of gas and steam engines. Present practice indicates that about 3 lbs. of steam are generated per b.h.p.-hour by means of exhaust boilers. According to Mr. Chorlton, the use of exhaust boilers with efficient steam engines and specially designed gas engines of the 2-cycle type will effect marked thermal economies and reduce initial cost of the installation per horsepower.

With a specially designed combined compound engine and with a special arrangement of boiler, economizer pipes, superheaters in exhaust, etc., 50 per cent. waste heat should be recoverable. There should be obtained, from this, 4 lbs. of steam per b.h.p.-hour. The steam cylinder used would be similar in type to that of the 2-cycle engine—with no exhaust valves. The uni-directional flow engine of this type gives very economical results. The jacketing of the ends could be done by exhaust gas. For small engines of this type it is safe to assume a steam consumption of 12 lbs. per b.h.p.-hour, hence the power obtained from the steam cylinder would be one-third of that of the gas cylinder and the consumption for total effective power would be reduced to less than that for the economical gas engine alone.

Surface Combustion.

By what he terms "surface combustion," Prof. Bone reports, for gas-fired boilers, evaporations of 21.6 lb. per sq. ft. of heating surface. The heat balance of a test reported by him shows:

Gas burned per hr. (at 32 deg. F. and 14.7 lb.) cu. ft.	997
Net calorific value of gas, B.T.U.	562
Total heat supply to boiler per hr., B.T.U.	559,800
Temperature of feedwater, deg. F.	42
Pressure of steam, lb.	100
Water evaporated per hr., lb.	450.3
Water evaporated from and at 212 deg. F., lb.	550
Heat transmitted to water, B.T.U. = 450.3×1172 =	527,800
Heat ratio 527,800÷559,860	0.943

He calls attention to the fact that the combustion was perfect, as shown by analysis. An efficiency of 94 per cent. was obtained, and deducting 4 per cent. for the power required for supplying air pressure, there is still left 90 per cent. Continuing, he says:—"The new boilers could be set up in brick work and require no elaborate flues or chimneys. They are liable to no strains as they are short. With some sacrifice of efficiency, the evaporation could be raised to 30 lbs. per sq. ft. The steam was raised quickly (steam at 100 lbs. pressure obtained in 20 minutes from cold start), and tubes could be grouped and cut out separately so as to vary the fuel consumption to suit the fluctuations of load."

In the first foot of the tubes 65 per cent. of the steam was generated; 25 per cent. in the second foot, and 10 per cent. in the third.

Producer Gas from Low-Grade Fuels.

The investigations of the Canadian Government show that peat can be prepared for fuel purposes at a cost averaging from 30 to 40 per cent. of that of an equivalent B.T.U. value in anthracite in Canada. As the foundation of a method that may result in extensive use of high-ash fuels without prohibitive cost of operation, attention is directed to the present producer-gas investigations of the United States Bureau of Mines, resulting in the successful fusing of the ash and the use of water-cooled producer linings. In line with this specific conservation of fuel resources, it is stated that the United States Steel Corporation alone, through its installations of blast-furnace gas engines, displaces or saves a consumption of approximately 1,000,000 tons of coal per annum as against the old-fashioned methods.

Small Producers for Bituminous Coal.

Reports indicate the successful development of gas producers of small power to operate on bituminous coal, coke breeze, anthracite screenings, "front end cinders," etc. A company manufacturing anthracite gas producers and gas engines, which expressed its firm conviction in 1904 that the Government tests with bituminous coal in producers would fail utterly, recently put itself on record as recommending the use of its own engines with small bituminous producers manufactured by another company.

Crude-Oil Gas Producers.

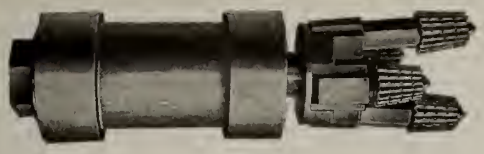
The development of the crude-oil gas producer, for which there is great demand in oil regions remote from the coal fields has been exceedingly slow, but it is believed that very definite progress has recently been made. In the Grine oil producer, a steam spray is used to atomize the oil, which is introduced into the upper part of the generator where partial combustion takes place. The down-draft principle is then applied, the hydrocarbon broken up, and the tar fixed by passing through a bed of incandescent coke. Mr. Grine reports that a power plant using one of these producers has been in operation for one year in California. With crude oil as fuel costing 95 cents per bbl., or 2.3 cents per gal., the plant develops the same amount of power per gallon of crude oil as is ordinarily developed by the standard internal-combustion engine operating on distillate at 7 cents per gal. Including the cost of fuel, labor, supplies, interest, depreciation and taxes, the cost per B.H.P.-hour is 0.76 cents for a plant of 100 h.p. rating.

The opportunity for investigation in the gas power fields is at present unlimited, as is evidenced by the fact that nearly 100 important gas-power problems are now on file at the United States Bureau of Mines, under the head of Proposed Investigations.

REMOVAL OF HEADQUARTERS.

The Canadian head office of Escher, Wyss & Co., engineers, of Zurich, Switzerland, is being removed to the Canadian Express Co. Building, Montreal, on May 1. The present headquarters is 408 Lumsden Building, Toronto. Larger accommodation has been secured to cope with increasing development of the business.

Chief Engineer Conway, British Columbia Electric Railway Co., recently delivered an address on subaqueous tunnel work before the company section of the N. E. L. A. The lecture was illustrated by lantern slides showing the method of operations and progress of great tunnel works in the Old Country and this continent. It was greatly appreciated by the large audience. Mr. Conway also gave an illustrated lecture recently before the Archaeological Society of B. C. on the great bridges of the world.



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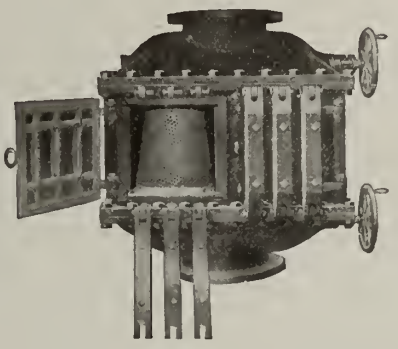
You are interested in reducing the cost of plant operation. Then look at the water you are using and the refuse in it. This refuse will decrease the efficiency of pumps and boilers. To remove it from them takes time and costs money. Save that labor and expense. Install a Twin Strainer and let it catch all the ice, sticks, leaves, grass, etc.



It takes but a few minutes to clean a Twin Strainer. While your are cleaning one side, the other side strains the trash out of the water. The trash is caught in a basket which is easily and quickly emptied. The flow of water is continuous and uninterrupted. A Twin Strainer is the simplest device of its kind and pays for itself in a short time.

So thoroughly does the Liberty-Greenaway Oil Separator remove oil from exhaust steam that the condensed steam can be used for the manufacture of artificial ice. You will be unable to detect any oil in the ice.

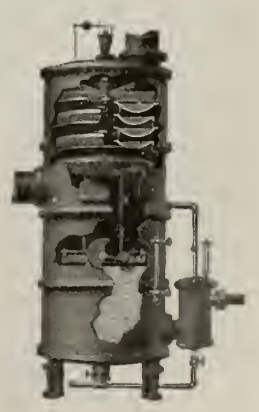
This would not be possible if the Separator were not absolutely correct in construction. The baffles do the work. These consist of two rows of "V" plates, which give the steam the exact number of deflections required for best results.

All Oil Separators should be cleaned. Note the cover is removable. All you do to clean the Liberty-Greenaway is remove the cover, take out the baffles. No joints to break.

Pittsburgh Feed Water Heaters are designed and built to give ths best results with the least amount of labor, attention and cost. There are no extra parts to increase the cost of maintenance and in no way improve the operation or efficiency.

Ample water and steam space is essential. Compare these in the Pittsburgh Heater to those of other heaters. You will soon find out which Heater will raise the feed water to the proper temperature with the minimum quantity of steam.

High efficiency at minimum expense is what you get from Pittsburgh Heaters.



WRITE OUR NEAREST BRANCH

MONTREAL, 320 St. James Street. TORONTO, 95-97 Front Street. WINNIPEG, 260 Princess Street.

ELLIOTT COMPANY

6902 Susquehanna Street, PITTSBURGH, PA.

The advertiser would like to know where you saw his advertisement—tell him.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

Prince Rupert.—The contract of supplying this city with 3,800 feet of 18-inch diameter steel pipe has been awarded to Evans, Coleman and Evans, of Vancouver.

Victoria.—The municipal council of Oak Bay have awarded the contract for a supply of water pipe to Robert McLaren & Sons, of Glasgow, through Forsyth & Co., who represent this firm. Their figures were $28,701.21 (including $690.50) for specials. Other firms tendered as follows: Evans, Coleman & Evans, $28,861.60 (including $675.70 for specials); Victoria Machinery Company, $29,203.07; W. J. Winterburn, $31,271 (including $567 for specials); Canada Foundry Co., $31,423.50 (including $675 for specials); Robertson Godson Co., $36,867.95; Hutchison Bros., $784 for specials.

ALBERTA.

Edmonton.—The commission reporting on a water supply have made the following recommendations: That an additional 6,000,000 gallon low lift pump, and an additional 6,000,000 gallon service pump be installed. Installation of gauges to determine run off and rain fall at Pigeon Lake.

Calgary.—The contract for the supply of one 2,500 k.w. steam turbine with Vickers generator for the city of Calgary municipal electric light and power plant has been awarded to Laurie & Lamb, Montreal, for $42,750, and for switchboards and apparatus, to P. S. McLaren, Ltd., for $6,640.40.

ONTARIO.

Merritton.—The Interlake Paper Company have awarded the contract for their new plant, and work has commenced. The architect is D. J. Albertson, Kalamazoo, Mich., and the general contractors are the Bishop Construction Co., Toronto. The building will be 208 ft. x 70 ft., of reinforced concrete, steel and brick, with concrete foundation, and steam heated. The contract also includes electric lighting, wood and concrete floors, sprinkler system, motors, all electrical work, boilers, engines, factory and mill machinery and freight elevators.

Niagara Falls.—The Dominion Government have decided to construct a new power house and pumping station at this point. This will remove the present plant from Table Rock.

Ottawa.—The estimates for civic lighting call for cluster lights to he installed on Lady Grey Road for a distance of about two miles.

Welland.—The municipal council have passed a by-law whereby that body will offer the Welland Electrical Company the sum of $50,000 for their plant.

Galt.—The municipal water board are preparing to install a synchronous motor in the pumping plant. The machine will operate on the mains of the hydro-electric commission. Specifications are prepared for a one-and-a-half million gallon pump for the above.

Toronto.—Plans and specifications for large additions to the plant of the Goldie & McCulloch Co., Limited, Galt, Ont., are being prepared by T. Pringle & Son, Limited, Industrial Engineers, Continental Life Building, Toronto.

Fort William.—Mr. E. J. Greenstreet, Toronto, architect for the Laing, Matthews Packing Co., will design and lay out a large warehouse for that firm in this city. It is understood that Mr. Greenstreet will also prepare plans for the erection of warehouses in Sudhury and Winnipeg.

Oshawa.—The Electric Power Company have arranged to instal an auxiliary plant here during the company season. A plant of 5,000 h.p. capacity and an ultimate expenditure of about six hundred thousand dollars is proposed. The design will provide for installation of additional units from time to time, as the demand for electric power in Oshawa factories increases.

Kingston.—The City Council will secure the services of R. S. Welch, of Montreal, as expert to consider the power offers the city has received from the Hydro-Electric Commission and Seymour Power Company. He will be paid a salary of $1,000 for the work.

BRITISH COLUMBIA ELECTRIC RAILWAY.

The British Columbia Electric Railway Co. has placed an order for 24 interurban cars with the St. Louis Car Co., the additional rolling stock with electrical equipment representing an outlay of $250,000. Twenty-two of the cars are intended for passenger service. These will he 50 foot cars providing seating accommodation for 64 persons, 44 in the main section and 20 in the smoking compartment. They will be of "ironclad" construction, solid steel riveted plates forming a band around the entire body of the car. The roof will be of the arch type and slat seats will be used for sanitary reasons. The air brake equipment, interior finish and fittings will be in accordance with the latest improvements known to carbuilders. The electrical equipment will consist of four 75 h.p. motors. The haggage cars will he 55 feet in length and similar in construction to the cars now used for the purpose on the company's Fraser Valley branch. The contract calls for the contract being carried out within 85 days.

Plans have been prepared for a new substaton on Earl's Road, South Vancouver, for the regulation of its light and power service in that district as well as on the West minster interurhan line, along which the station is located. The building will be 70 by 86 feet in size, one story in height with an additional half story at one end for transformer gallery; the type of construction being reinforced concrete. The electrical equipment will consist of two 1,000 k.w. motor generator sets, two banks of transformers of 3,000 k.w. each for light and power service, eight arc regulators with a total capacity for 800 lamps and a switching station for a 10,000 volt feeder switch. The total investment at this point will he $125,000.

The work at Earl's Road forms a part of the company's program for the improvement of its power plants and suhstations, extension of its light and power service, etc., on which its management will expend nearly $3,000,000 during the present season. This program includes the development of the North Arm hydro electric plant by the addition of three 14,000 h.p. units at a cost of $1,000,000; the addition of a 5,000 k.w. turbo-generator at the Vancouver steam auxiliary plant at a cost of $250,000; the doubling of the capacity of the substations at Vancouver, Lulu Island, Point Grey, New Westminster and Burnaby, and general light and power extension works.

Operations are steadily progressing on the preliminary work for the additional installation at the North Arm hydro electric plant, 900 men heing now engaged in connection with the operations on the new dam at the outlet of Lake Coquitlam. This number will he raised to 1,300 men as the outdoor working seasou opens. At Lake Buntzen ahout 400 feet has been driven on the 2,250 foot tunnel which will convey the water from the dam to the generating station. This work is now being rushed, operations being carried on through two shafts, 75 feet in depth. About 40,000 cubic yards of granite have been cleared away on the site for the new station. At Lake Coquitlam about 50,000 cuhic yards have been placed in the toe wall of the large dam and the work of cementing the tunnel, which will divert the river 28 by 18 feet is now in progress. Extensive clearing operations and installation of special equipment for the New Westminster water supply are also heing carried on.

TRADE NOTES.

John Millen & Son, Ltd., Montreal, have been awarded the contract for Chain Drives aggregating 200 h.p., for the hlg addition to the Grand Trunk Pacific Elevator at West Fort William, which is being erected hy John S. Metcalfe & Co. The Chain Drive selected is the famous Coventry Noiseless.

The Armstrong Machinery Co., Spokane, have Instalfed the following refrigeration units recently:—one 4 ton Armstrong machine for P. Burns & Co., Grand Forks, B.C.; one 2 ton Siberian machine for L. A. Smith & Co., Anaconder, B.C, and a 4 ton refrigeration plant for the Grand Forks Brewing Co., Grand Forks, B.C.

CATALOGS.

A copy of the catalog illustratlng the Bennis patent chaiu Grate Stoker, manufactured by **Ed. Bennis & Co., Little Hutton, Bolton,** has been received. Numerous cuts of plants which are using this automatic stoker are shown and a short account of each installation is given, with a few comparative figures. Geo. H. Tod, Manning Chambers, Queen St. W., Toronto, is the Canadian representative.

The Homestead Manufacturing Co., Homestead, Pa., have forwarded us a very attractive copy of their 1912 catalog illustrating to advantage the great variety of their product. Each individual value is very clearly shown by excellent cuts and in many instances a cross-section or diagrammatical view is also furnished. Both the flanged and threaded connection types are illustrated, and price lists of the various types and sizes are arranged under the corresponding cuts. The valves of more uncommon construction, such as their three-way and four-way types, are of a pleasing, compact and yet suhstantial design. The book voices a very eloquent appeal for a share of the trade which an artlcle of such excellent quality merits.

A short treatise on **Non-Pulsating Pumps** issued by the **Luitwieler Pumping Engine Co.,** Rochester, N.Y., has been forwarded us hy their **Canadian representatives, The General Machinery Co., Toronto.** The catalog dwells upon the outstanding features of the pumps, particularly that of a uniform discharge. The cuts represent several machines in operation under rather trying conditions, which especially emphasize the fact that there is a distinct absence of vibration. The points of superiority are clearly and concisely treated. and numerous illustrations show these pumps connected to steam, gasolene and electric units. A few testimonial letters are printed which convince one of the high quality of this company's product.

The Canadian H. W. Johns-Manville Co., have forwarded us a copy of thelr catalogue "Modern Illumination" which describes the Frink System. Illumination has been a life study of I. P. Frank, Esq., and some Illustrations of the success with which he has met are shown here. His system is more particularly adapted for banks, insurance companies, and other large office huildings.

Watson and McDaniel Co., 146 North Seventh Street, Philadelphia, Pa., have issued a handy little booklet of pocket size describing steam specialties. The illustrations are neat and attractive and by means of sectional views the various accessories to the steam plant are thoroughly described. The catalogue treats of steam traps, seamless copper hall floats, screens and strainers, exhaust pipe heads, relief valves, reducing valves, water reducing valves, air and gas reducing valves, throttling steam pump governors, intermittent steam pump governors, suction tees, water lifters, syphon pumps, steam separators, blow-off and hydraulic valves. The book consists of 54 pages 3½ ln. x 6 in. and should he valuahle to all engineers.

The Kelly Foundry and Machine Co., Goshen, Ind., have issued a catalogue describing their latest Rocking and Shaking Grates. The many superior features of these grates are emphasized and clearly shown by sectlonal illustrations. Their stationary grates are also shown. Any person interested ln grates should not fail to become acquainted with the product of this firm.

POWER CABLES

British Insulated & Helsby Cables

Limited

Paid-up Capital, - - $8,500,000.00

Head Office:

Prescott, England

Works:

Prescott
Helsby
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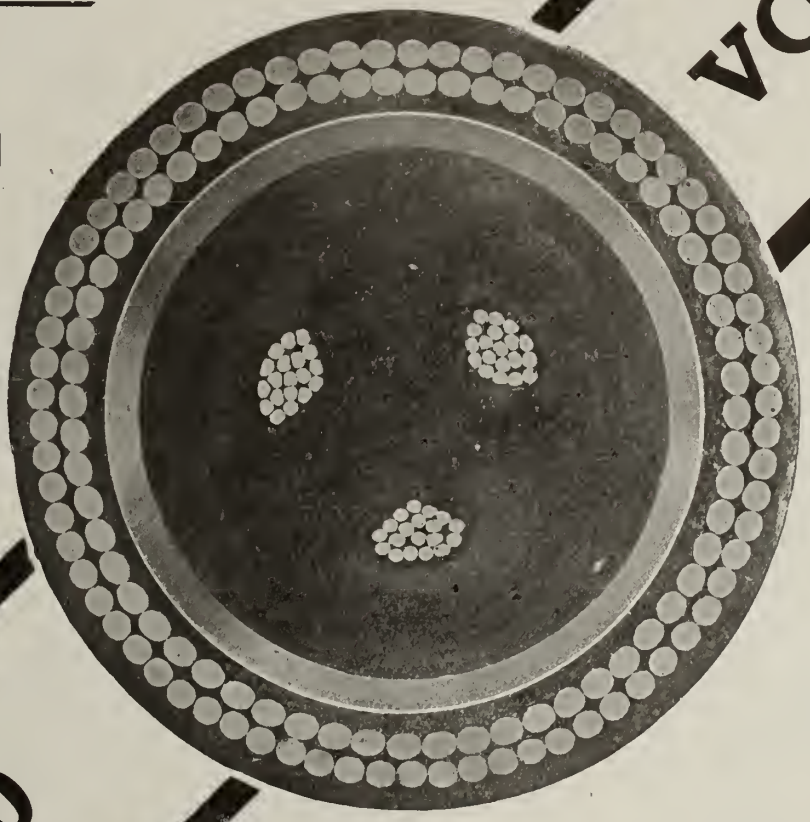
25,000 VOLTS



This submarine cable was made by us for the Kaministiquia Power Co., to the specification of

R. S. Kelsch, Esq., Consulting Engineer, Montreal.

It is paper-insulated, lead covered and steel armoured.

SOLE CANADIAN REPRESENTATIVES:

Canadian British Insulated Company, Ltd.

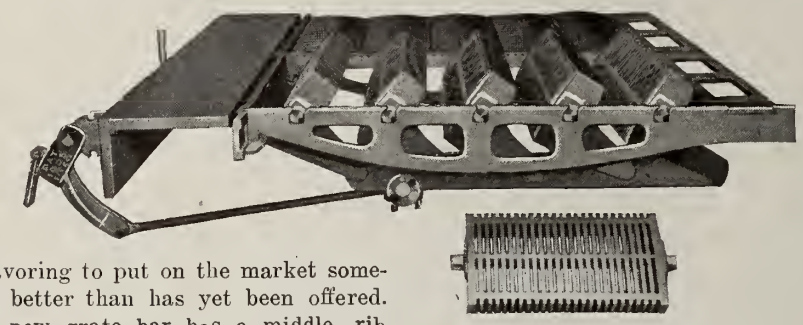
MONTREAL

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

IMPROVED SHAKING GRATE.

THE Canadian Steam Boiler Equipment Co., who have been favorably known for some time past as the manufacturers of the Cyclone Shaking and Dumping Grate, have not been content to produce an article "as good" as that of their competitors but have been endeavoring to put on the market something better than has yet been offered.

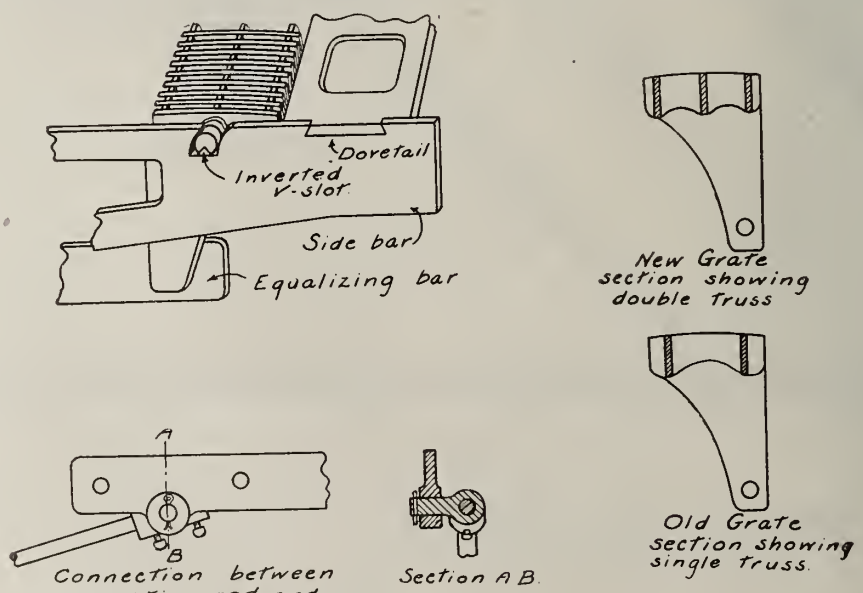


Improved Shaking Grate.

The new grate bar has a middle rib which is an added feature, and around which a great many improvements are centred. It gives large additional strength to the centre of the bar, the face of which has been increased from 8 to 9 inches. The dumping space is also increased from 2 3-4 to 5 3-4 inches. Thus, large clinkers are now able to find their way to the ash pit, whereas, previously they would remain above and tend to choke the draught. Again, the size of the clinker breakers or teeth at the sides of the grates has been greatly reduced.

Despite the fact that the bars are considerably stronger, the air space has not been lessened. The three ribs offer less frictional resistance to the air than did the two larger ones previously. The middle rib prevents the main rush of air concentrating at the middle of the grate bars and thus producing the greatest heat there, a cause of their burning out sooner than they should were the distribution of air more uniform. To prevent accumulation of ashes in the center of the grate a new device has been embodied in the design. The trunnion slots in the side bars are flat on the bottom, and on the trunnion bottom are cast inverted V-slots. When shaking, the weight of the bars is alternately on the points. This gives a decided jar to the grates, causing the ashes to sift through to the pit. The ashes have only to be displaced 3-8 inch at most to drop into the slots.

Sometimes trouble has arisen because the side-bars were not correctly spaced, and occasionally a grate bar would drop into the ash pit. In the new grates, the bridge wall racks dovetail into the side-bars which makes it imperative for the masons or builders to construct their part of the work so as to obviate all danger of spreading side-bars. A further improvement is found in the method of attaching the connecting-rod to the equalizing bar. The rod slides into a long collar on one side of which is cast a pin. Two set screws secure the rod, and the pin, passing through a boss cast in the equalizing bar, is prevented from coming out by a split pin. The ease with which the collar can be removed from the equalizing bar or connecting-rod is apparent. Thus adjustments and replacements are very simple matters.



Details of Improved Shaking Grate.

STEAM CONSUMPTION QUERY.

IT is not possible to make calculation of the steam consumption of your pump, as we have no particulars of the amount of admission, but even were this available the degree of accuracy would still be questionable. By weighing the exhaust steam from your pump, when condensed, and making some allowance for leakage—the latter amount being readily noted from careful observation, you will arrive at the proper quantity of steam being used in a given time.

St. John, N. B.—Forty candidates for stationary engineers' certificates recently completed the examination before John Kenney, jr., factory inspector.

CATALOGUES.

We are in receipt of an attractive little catalog of pocket size, 3¼ in. x 6¼ in., issued by the **Marion Machine Foundry and Supply Co., Marion, Ind.** Their rotary Soot Blowers are well illustrated and described, and application to several types of boilers is discussed in detail.

W. Christie & Co., Glasgow, Scotland, have mailed us a copy of their latest catalogue of dynamo and motor brushes, Galvanic Metal Packings, etc. The several varieties of Pliable, Self-Lubricating Brushes are attractively illustrated and attention drawn to the points of superiority. The line of metal packings is also well illustrated and suggestions as to the manner this packing can be used to best advantage are offered.

A very attractive little book has been forwarded to us by **W. Sisson & Co.**, Gloucester, Eng., illustrating their stationary and marine engines. Most of the engines described are small units. Their stationary units consist of several types, single cylinder, tandem and cross compound, all vertical. The designs are neat and extremely compact, and the engines while weighing little per h.p., appear to be built in every way equal to the duty they are required to perform. The marine types attract especial attention, being of exceptionally smart design. A special inclined cylinder engine, constructed for a single stern wheel steamer on the Congo River, is well illustrated and presents some unique features. The catalog is a pocket edition, being 8 in. x 5 in. Screw wheels are another specialty of this firm.

The Garlock Packing Co., Hamilton, Ont., have forwarded us a copy of their latest catalog. The variety of packings described and illustrated is almost unlimited. If there is a particularly difficult problem in packing, one is almost certain to find something here that will suit the circumstances. The catalog impresses upon the reader the eagerness which the company exhibits to solve difficult problems in their line. They make a specialty in packing compressors and other machines where the circumstances vary somewhat from the ordinary proposition. Among other lines shown are gaskets, pipe covering, rubber hose, gauge glasses, rubber belting, belt dressing, steel belt lacing, tube cleaners, packing tool outfits, etc., etc.

The Steam Appliance Co., Milwaukee, Wis., have forwarded us a copy of their Steam Specialty catalog No. 17. Among the various lines taken up in the catalog are "The Triumph Oil Separator," "The Victor Horizontal and vertical Steam Separator," "Victor Receiver Separator" in horizontal, angle and vertical types; "Victor Ammonia Separators," "Triumph Exhaust Head," "Peters' Corliss Valve Steam Trap," "Peters' Grease Trap," "The Henry Steam Flue Cleaner," etc., etc. These are all high-class specialties and accessories and the catalog will be extremely useful to those who have to do with steam plant equipment and operation.

THE RICHARDSON-PHENIX CO.

To take care of the increased demand for special investigations of problems pertaining to scientific lubrication, the Richardson-Phenix Co., lubrication engineers and manufacturers, Milwaukee, Wis., announce that Mr. C. Lee Straub has recently been placed in charge of this department, making his headquarters at the New York Office, Hudson Terminal Building. Mr. Straub is a graduate of the Lehigh University and has had a broad experience on large engineering enterprises. He was for some time connected with the Bethlehem Steel Company and later was in charge of the Producer Gas and Engine Department of the Power & Mining Machinery Co., and for the past few years has been engaged in consulting engineering. Mr. Straub is well fitted to make special investigations of all problems concerning scientific and economical lubrication of power plant machinery, transmission machinery, machine tools, etc. Any installation necessitating unusual equipment or design of special lubricating apparatus will be given his special attention. This service of advising on the solution of lubricating problems is furnished free to its customers and clients by the Richardson-Phenix Co.

PRINTING

BOOKLETS, CATALOGUES, PRICE LISTS, Handbills and any other fine printing at fiercely competitive prices. Russell Smart Advertising Agency, 40v, Chancery Lane, London, England. (7)

CLASSIFIED ADVERTISING

FOR SALE

BELTING FOR SALE—800,000 FEET OF best quality leather, rubber, hair and canvas belting, bought from bankrupt manufacturers at 25% to 75% less than the regular value. Also a large quantity of slightly used belting, piping, chains, rails, pulleys, hangers, cotton waste, etc., at very low prices. Send for catalogue. Imperial Belting and Supply Co., 5 Queen Street, Montreal.

WANTED

WANTED—EVERY POWER HOUSE IN Canada to remember that C. E. Shedrick, Craig Street West, Montreal, is still repairing measuring instruments, both switchboard and portable. Twenty-five years' experience in repairing all kinds and makes on the market. Intregating meters repaired, tested and sealed, and returned on quick time.

SALESMEN WANTED

LAKE ERIE BOILER COMPOUND CO. REquire a few first-class representatives to sell their well-known compound. Liberal commission paid to live men, and exclusive territory. Write at once, giving references, 11 Colborne St., Toronto. (tf)

SITUATIONS WANTED

ELECTRICAL ENGINEER, NOW IN CHARGE of operating department of large power company, wants change. Experience with 10,000 v., 3-phase, 50-cycle overhead and underground mains and sub-stations. Box No. 115, The Power House, Toronto.

SALESMAN'S POSITION, EXPERIENCE IN Canada and England. Steady and reliable, age 34, engineering or electrical specialty preferred. Highest recommendation. Address, J. Snowball, 1023 Second Avenue E., Owen Sound, Ont.

MISCELLANEOUS

MODERN FIREPROOF CONSTRUCTION—Our system of reinforced concrete work—as successfully used in many of Canada's largest buildings—gives better results at lower cost. "A strong statement," you will say. Write us and let us prove our claims. That's fair. Leach Concrete Co., Limited, 100 King St. West, Toronto (tf)

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Forbes Motor Driven
PIPE CUTTING AND THREADING MACHINE

has all the advantages of the belt driven type, with compactness, power-saving and unusual operating convenience in addition. The motor is concealed inside the base of machine, the various speed changes are under lever control: no friction losses, no wasted power.

The absence of countershafts permits heavy lengths of pipe to be handled with cranes or overhead trolleys, or the machine can be taken to the work.

Full description on request. Write us.

The Curtis & Curtis Co.
26 Garden St. - Bridgeport, Conn.

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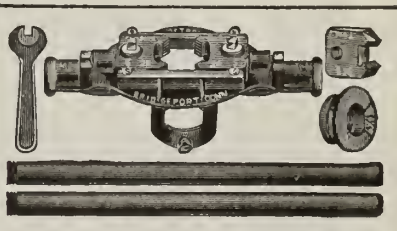
The difference between engineers who "shut 'em down" and those who "keep 'em going" is often the difference between engineers who merely "oil 'em up" and those who use

Dixon's Flake GRAPHITE

"The world's most perfect lubricant."

If you are not among the thousands of engineers who keep things running smoothly, you owe it to yourself to write for "Graphite as a Lubricant" and free Sample 222c.

JOSEPH DIXON CRUCIBLE CO.
Jersey City, N.J.



GENUINE ARMSTRONG STOCKS AND DIES FOR CUTTING PIPE & BOLTS ARE THE BEST.

PIPE MACHINES
PIPE CUTTERS
HINGED PIPE VISES
RATCHET ATTACHMENTS

Manufactured by
THE ARMSTRONG MFG. CO.
298 Knowlton St.
BRIDGEPORT, CONN.
NEW YORK *CHICAGO*
Catalog mailed on request

The advertiser would like to know where you saw his advertisement—tell him.

Power Equipment for Sale

2—Tandem Compound Wheelock Engines, cylinders 21" and 38" x 46" stroke.
2—Fly-wheels 18' diameter, 46" face.
2—Double leather belts, each 112' long, 42" wide.
2—Tubular water heaters.
2—Northey jet condensers, cylinders 12" and 18" x 18" stroke.
1—6" line shaft, 15' long, with friction coupling and pulley 4' 11" x 46".
6—Fire tube boilers, each 63" diameter, 14' long, containing 84 three-inch tubes. Pressure allowed by Boiler Insurance Co., 110 lbs. per sq. inch.
2—Northey feed pumps, cylinders 5" and 8" x 12" stroke.

All the above steam and water connections in very good order. These engines were started in 1894, but were seldom used, being an Auxiliary Plant. Offers will be received for all or any of this plant by

THE OTTAWA ELECTRIC COMPANY, 35 Sparks Street, OTTAWA, ONT.

NOTICE

To Engineers and those interested in boiler and furnace construction.

The invention covered by Canadian Patent No. 124,725 granted to Thaddeus Venson Elliott, of New York, N.Y., U.S.A., for improvements in Mechanical Stokers, is being manufactured by Caledonia Iron Works, 572 William St., Montreal, who is prepared to supply any demand therefor. Applications should be made to Messrs. PLEWS & LARIN, 1 Bishop St., Montreal.

OWEN N. EVANS
Solicitor of Patents, etc.
205 St. James Street, Montreal.

Eugene F. Phillips Electrical Works, Limited
MONTREAL CANADA

Bare and Insulated Electric Wire
Electric Light Line Wire. Incandescent or Flexible Cords.

Railway Feeder and Trolley Wire
Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.

HALIFAX TORONTO WINNIPEG VANCOUVER

Don't Burn Your Money

Look for the White Porcelain Base.

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BERGMANN

Incandescent Lamps

Metal Filament

70% SAVING IN CURRENT

Carbon Filament

COMPLETE STOCK. ***IMMEDIATE DELIVERY.***

Exclusive Distributing Agents for Canada:

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339 Craig Street West - MONTREAL

3000 Kw.—220 V.—D. C. Front View.

Northern Electric Switchboards

You must have QUALITY in a switchboard to insure satisfactory operation throughout its life.

We manufacture POWER SWITCHBOARDS of every description and equip our boards with the following apparatus of QUALITY:—

WESTON INSTRUMENTS
CONDIT OIL SWITCHES
CONDIT CIRCUIT BREAKERS
TAUNTON-NEW BEDFORD KNIFE SWITCHES

SLATE, MARBLE and all other accessories are selected, with QUALITY as our only consideration. In addition the board is designed and built by experts.

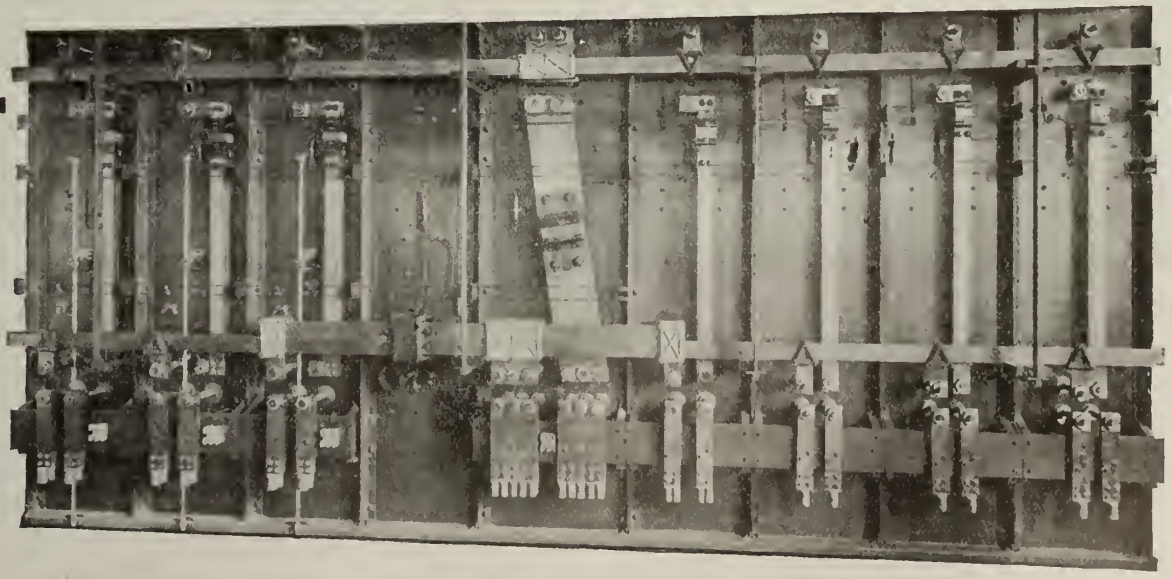
"NORTHERN ELECTRIC QUALITY" insures the elimination of trouble.

For full particulars address Desk 2070.

THE Northern Electric AND MANUFACTURING CO. LIMITED

Manufacturer and Distributor of Telephone Apparatus, Electrical Supplies, and Fire Alarm Apparatus for every possible need.

Address our nearest house: Montreal Toronto Winnipeg Regina Calgary Vancouver



3000 Kw.—220 V.—D. C. Back View.

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They are both made by first-class mechanics, and are articles that every Engineer should have.

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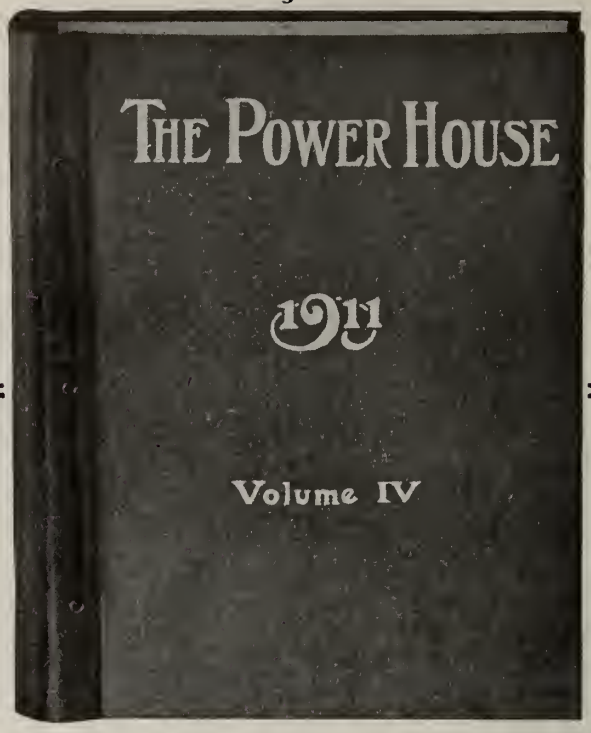
143 UNIVERSITY AVE. - TORONTO



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A complete alphabetical index of articles published during 1911 is bound in the back of this issue and can be easily removed.

Price, Postpaid, 50 cents.

THE POWER HOUSE
143 UNIVERSITY AVENUE
TORONTO

WAINWRIGHT WATER HEATERS

A Unit saved from the exhaust is worth two in the coal pile.

WAINWRIGHT WATER HEATERS are designed specially to fulfill the requirements of Bleacheries, Dyehouses, Paper Mills, Laundries

ALBERGER CONDENSOR CO.

140 Cedar Street, NEW YORK CITY

Agents: CANADIAN FAIRBANKS CO., Limited
Montreal, Toronto, Winnipeg, Vancouver

Mueller Pressure Reducing and Regulating Valves

Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

DOHERTY MFG. CO., Limited
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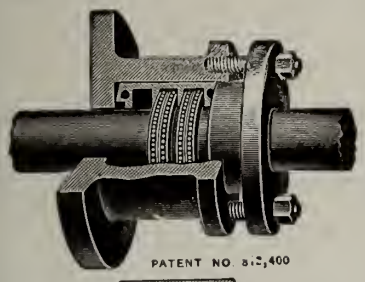
Manufacturer for The H. MUELLER MFG. CO., Decatur, Ill., and New York City.



PATENT NO. 812,400

PAT. NO. 486,177 " " 500,699 " " 534,104 " " 802,328

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Why not Buy the Best, when in market for Packing?

HOLMES'
Metallic Packing
is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

The Nokoros Patent Union

The only union made absolutely Non-Corrosive. Brass to iron in all contact points. Ball joint; Octagon ends, any wrench can be used. Adapted for heavy service. Every union air tested at factory. Send for circular B, describing the above and other fittings made by

G Tested & Uarantee D

OTTERVILLE MFG. CO., LIMITED
OTTERVILLE, ONTARIO

Mr. Manufacturer

Are You Satisfied With

YOUR LIGHTING

Good lighting means better work.
If interested, write us.

A. H. WINTER JOYNER, LTD.
76 Bay Street Toronto, Ont.
"Consult a Specialist"

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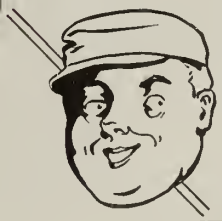
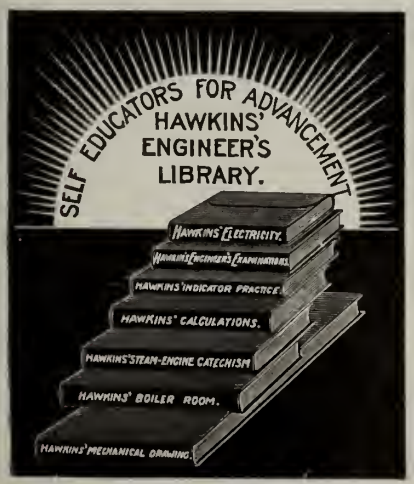
ALL LUBRICANT—NO WASTE

A small quantity of Albany Grease lasts longer than a large quantity of any other lubricant. It's wasteless, and the greatest natural friction reducer.



A liberal sample of Albany Grease, an Albany Grease Cup, and our new book "Death to Friction" will be sent free of charge upon receipt of your name and address. Why not take us up?

ALBANY LUBRICATING CO., Sole Makers
Adam Cook's Sons, Props.
708-710 Washington St. NEW YORK



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Every Engineer, Superintendent, Machinist, Electrician or Power User should have the well-known "Hawkins' Works" at hand for self help, study and ready reference. The seven books shown in illustration with their titles are the most complete and helpful works published for the practical man. They are convenient in size, and well bound, containing 2268 pages, 5171 ready references on engineering practice, 1188 questions and answers, 444 standard rules, 1258 illustrations and diagrams, making them a mine of the best and most reliable information obtainable on steam, electrical engineering and mechanical drawing. Sold on very easy payments as shown below.

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Detroit Lubricators for every purpose

TRADE MARK
REG. U.S. PAT. OFF.

Detroit Lubricators are made in styles and sizes for every kind of service.

Regardless of the conditions under which it must operate, there is a Detroit Lubricator that will eliminate every element of chance of uncertainty from the lubrication of the machine with which it is installed.

Every lubricator is carefully designed for the work it is to do and embodies in a compact and well balanced design all of the esentials of a perfect lubricating device.

Detroit Lubricators are characterized by all of the refinements and improvements made possible by long experience in the sale and manufacture of lubricating devices of every kind and by careful study of the varied conditions under which they are used on all kinds of engines, all over the world.

Engineering Service Department

The Detroit Lubricator Company maintains an engineering department that is at the service of users of lubricating devices. It is our aim to assist every owner of a Detroit Lubricator to get the greatest efficiency from it.

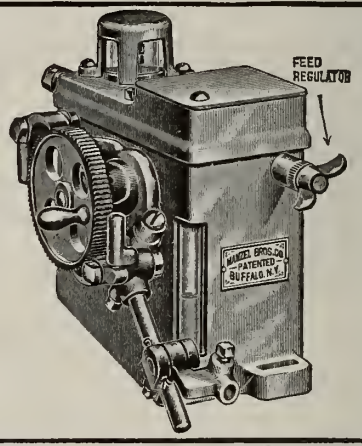
If he is not sure as to the exact style and size of lubricator his machine needs, if he is in doubt about the proper method of installation and operation—if he needs help of any kind, he can write us and our service department will be glad to to help him.

DETROIT LUBRICATOR COMPANY.

DETROIT, U.S.A.

Largest manufacturers of lubricating devices in the world.

Let Us Send You a Manzel Oil Saving Oil Pump on Thirty Days' Trial



30% OIL SAVING GUARANTEED

You may be able to save as high as 60%. Many others have done so. The "Manzel" New Model Oil Saving Oil Pump is a positive lubricator. It oils the cylinders right all the time, and makes a big reduction in oil bills, besides saving labor and wear and tear on the engine.

You can try a "Manzel" Pump with the distinct understanding that it may be returned at our expense if it doesn't reduce your oil bills at least 30%.

Send for one on these conditions. Catalogue on request.

MANZEL PUMPS are carried in stock by

THE TWIN CITY OIL CO.
General Agents Ontario and Quebec
Berlin, Ontario.

BAYFIELD & ARCHIBALD
General Agents for the Northwest.
Molsons Bank Bldg., Vancouver, B.C.

Write to either of the above firms for catalog and full information. MANZEL BROTHERS CO., Buffalo, N.Y.

When All Others Fail

GERMAN VALVE CYLINDER OIL,
GERMAN ENGINE OIL.
STERLING FAST ENGINE AND DYNAMO OIL,
STERLING FRICTIONLESS COMPOUND

will cure your troubles.

Canadian Oil Companies Limited,
Toronto, Winnipeg, Montreal, St. John, Halifax, Calgary.

"Philadelphia" Compressed Air

Grease Cups

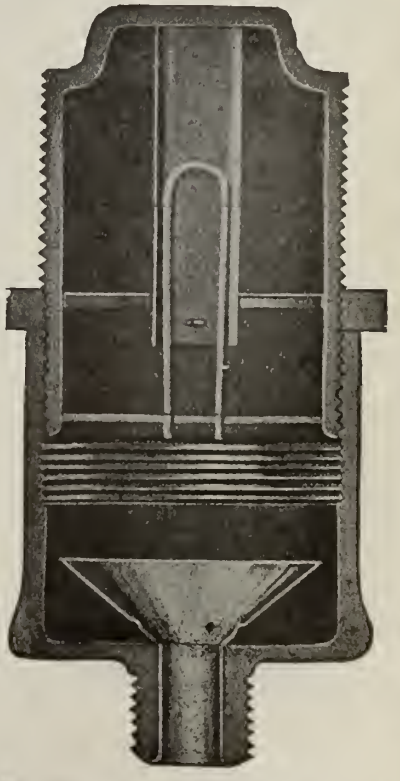
FIFTY PER CENT. SAVING GUARANTEED

Better and More Uniform Lubrication and Cheaper Than Oil

Why?

1. Oil used on machinery bearings cannot be controlled. Grease, rightly made and properly applied, is under perfect control and can be so regulated in its application as to insure the least possible frictional resistance.

2. More oil is wasted by careless application, by dripping and by being thrown from the moving parts, than is actually used as a lubricant. Grease does not drip nor splatter, and cleanliness is the rule rather than the exception.



3. Dust and grit will work in where oil is used, causing greater friction and wear on the bearings, unless shut out entirely by the use of oil cellars or tight shields which are inconvenient, more or less expensive, and can be applied to comparatively few places. With grease there is no need of shields or similar devices; dust and grit are positively excluded from the bearings, the grease working out around the collars, etc., making a perfect seat, and there is practically no wear at all on the journals.

Grease is solidified oil, and will show less frictional resistance than liquid oil.

Your engine will not "heat up." Dirt or grit cannot enter your cylinders or bearings. You will save tremendously over the cost of oil.

Peterborough Lubricator Mfg. Co., Limited

PETERBOROUGH, ONTARIO

The advertiser would like to know where you saw his advertisement—tell him.

NELSON Bronze Gate Valves

TRADE-MARK REGISTERED

All **NELSON** Valves are tested to more than double the pressure they will be subjected to in actual service. The test is so carefully made that a weak or defective valve cannot get out of our shops.

Nut screwed on, *not riveted*, can easily remove wheel to renew packing.

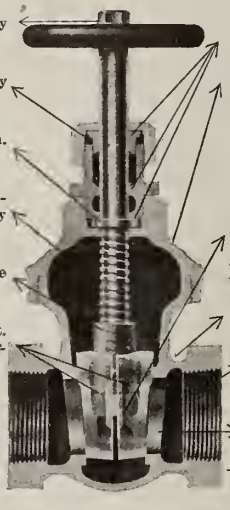
Gland on Medium and Extra Heavy valves.

Stem collar cast solidly on the stem. Collar is *always* there.

Threads. Scientifically and mechanically correct, strong, wear well, easy to operate.

Wedge. The only spreading device in the valve. *One piece.* Simple.

Discs. Two. Simple. Compact. Can't get out of order. Automatically rock into perfect alignment with the seats, not only when the seats are new, but should the seats become distorted from their original angle, through sagging of the pipe or otherwise, the discs will still *make up tight* with the seats.



Stem has bearing at *three* points, keeping the stem central and steady.

Bonnet. Screwed on outside of body on Medium and Extra Heavy valves, strengthening it for severe service. The outside bonnet is not used on Standard valves, as the body is made so strongly that it is not required for 125 pounds working pressure.

Disc Guides. These guide the discs freely, making operation easy, *no binding at any point*, prevent discs from scraping on the seats.

Body. *Strong*, because well proportioned, well balanced, curved shape.

Thrcads. Cut *taper*, to standard gauges, for good, tight, pipe connection.

100% opening, *no obstructions.*

Hexagons unusually long and very heavy.

We make nothing but valves, but we make all sizes, for any pressure, for every purpose, Gates, Globes, Angles, Checks and Blow-offs. High-grade valves exclusively. No competition stuff whatever.

Outside view of Standard Valve

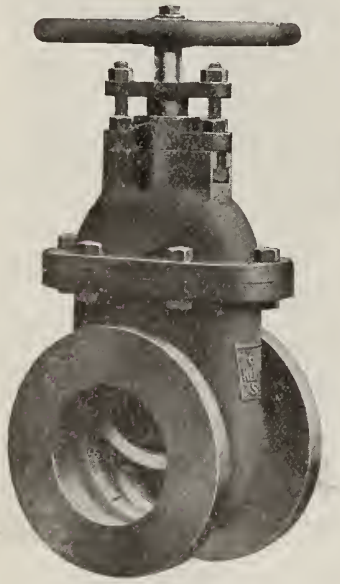
Extra Heavy, for 300 pounds. Medium, for 175 pounds. Standard, for 125 pounds.

Nelson Valve Company, Philadelphia

MONTREAL 12-14 University St. | NEW YORK 30 Church St. | CHICAGO 17 West Kinzie St | SAN FRANCISCO 22 Battery St. | PITTSBURGH 517 Liberty Ave.

MINNEAPOLIS 625 Andrus Bldg. | BUTTE 56 E. Broadway

Inside view of Standard Valve



6″ Flanged End Kerr Gate Valve

When next you order an Iron Body Gate Valve, specify

Kerr's New Pattern

LIKE THIS ILLUSTRATION

We want you to see and try what we know to be the strongest and best made Valve on the market for Standard pressure. Every Valve tested 300 pounds Hydraulic Pressure.

THE KERR ENGINE CO., Limited

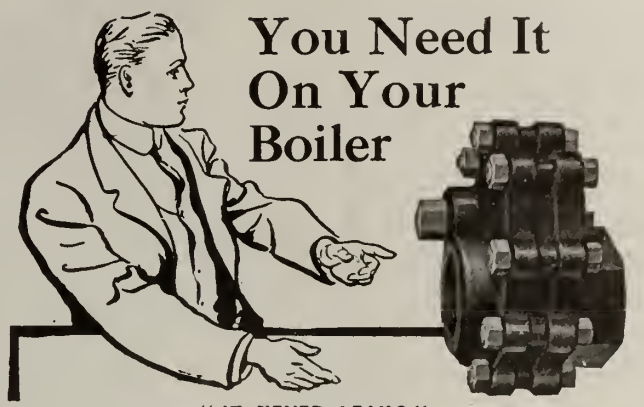
WALKERVILLE, ONTARIO.

DON'T FORGET THIS!

The "EVERLASTING" Blow-off Valve has made a reputation for itself, by its efficiency and lasting qualities. It has been tried out, and is now a Standard.

In use by

POWER PLANTS
RAILROADS
STEAMBOATS
GOVERNMENTS



You Need It On Your Boiler

"IT NEVER LEAKS"

Made in

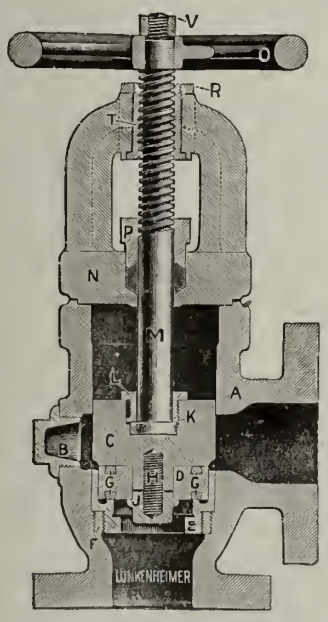
IRON BODY
SEMI BRASS
SOLID BRASS
ALL IRON

NOTICE.—We have started an information department, and will be pleased to give information on anything in connection with the Power Plant, Heating System or Steam Plant. We hope you will write us, and we will do our best to give you what information you need. Do not be bashful

Engineering Specialties Company

1080 King Street West TORONTO, ONTARIO

Agents: H. L. PEILER & CO., 380 St. James Street, Montreal, Que.



LUNKENHEIMER
is a name well known in the engineering field. It is synonymous with quality.

"DURO"
is a name synonymous with durability, and which, when associated with Lunkenheimer and

BLOW-OFF VALVES
is immediately recognized by engineers as the trade name of a valve without an equal.

LUNKENHEIMER "DURO" BLOW-OFF VALVES

are guaranteed for 250 pounds working pressure. The body is made of cast iron having a tensile strength of 25,000 pounds per square inch, and the high grade bronze used contains a large percentage of copper and tin.

One of the principal advantages in the design of these valves lies in the construction of the seat and disc, which **provide self-cleansing seating surfaces** so that any scale or grit lodging on the face of the seat will positively be washed off before the disc is firmly seated, thereby **insuring a perfectly tight valve.**

The **disc is double seated** and can be **reversed or renewed** when worn. The **seat** is also **renewable,** as are all other parts of the valve subjected to wear.

Lunkenheimer "Duro" Blow-off Valves are made in sizes ranging from 1¼-inch to 3 inches inclusive.

Specify and insist upon securing genuine **Lunkenheimer make.** Do not accept substitutes—they are never as good as the genuine.

"Most supply houses sell them—yours CAN—if they DONT or WONT—tell US."

THE LUNKENHEIMER COMPANY

Largest Manufacturers of high-grade Engineering Specialties in the World.

General Offices and Works: - - - - - CINCINNATI, OHIO, U.S.A.

CHICAGO	NEW YORK	BOSTON	LONDON, S.E.
186 North Dearborn Street	64-68 Fulton Street	138 High Street	35 Great Dover Street

The advertiser would like to know where you saw his advertisement—tell him.

THE
CANADIAN CASUALTY
AND
BOILER INSURANCE
COMPANY

SPECIALTY:

Boiler Inspecting, Reporting,
Insurance, Evaporation Tests

CONTINENTAL LIFE BUILDING
TORONTO

J. O. B. Latour
Chief Engineer.

John J. Durance,
Manager.

Phone Main 6941.

The
Morehead
Condenser
Trap
makes its
own
Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

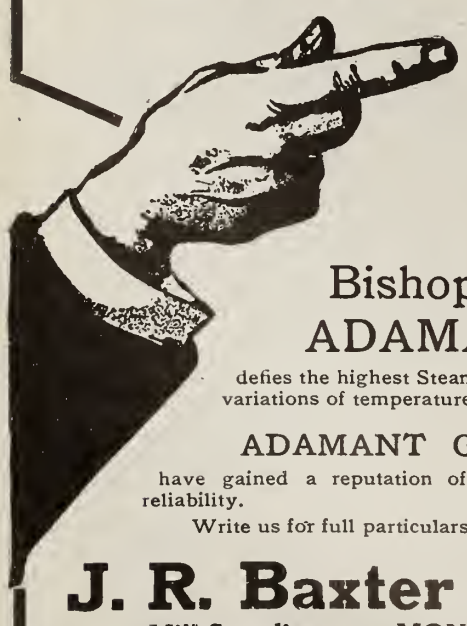
Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars

Morehead Mfg. Co.
DEPT. "J." DETROIT, Mich.

Canadian Representatives—Geo. W. Cole, c/o A. R. Williams Machinery Co., Toronto, Ont.; H. E. Kirkham, Montreal; Park Bros., Chatham, Ont.; W. H. Rosevear & Son, Winnipeg, Man. Robt. Hamilton, Vancouver, B.C.

The Utmost in
GAUGE GLASS
QUALITY



Bishops
ADAMANT
defies the highest Steam Pressures and all variations of temperature.

ADAMANT GLASSES
have gained a reputation of good service and reliability.

Write us for full particulars ***to-day.***

J. R. Baxter & Co.
Mill Supplies MONTREAL

TIMES CHANGE

So does the plant.

IF an engineer does not keep up-to-date, how long does it take to look elsewhere for a position?

IF the steam plant of any company or corporation is not up-to-date, how long does it take to find a leak?

These are not conundrums, but facts which confront us all.

The Heat and Pressure Control Co.

are experts in steam plant economics and are anxious to demonstrate what their appliances can do.

Don't fail to consult if you wish to be up-to-date in money-saving appliances.

WRITE OR CALL

603 Kent Building - - Toronto

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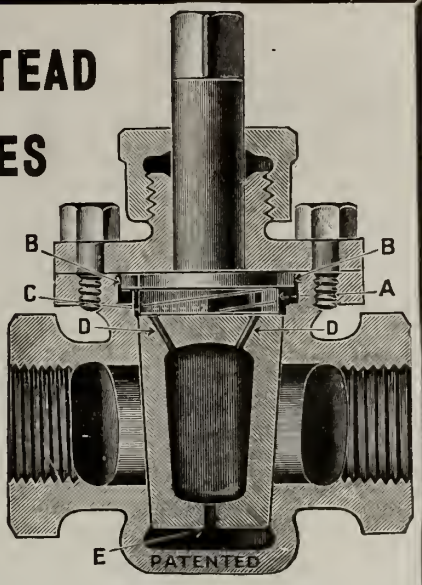
HOMESTEAD VALVES



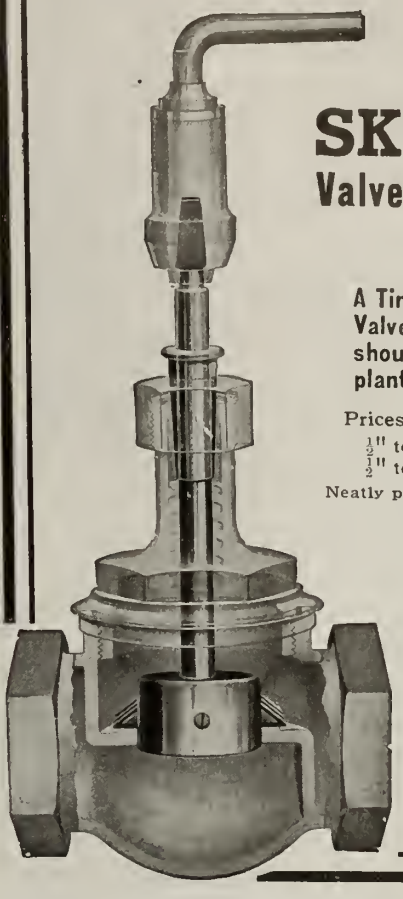
Have no Equal for Simplicity and Durability

They are unexcelled for any service involving the handling of high pressures in steam, gas, water or hydraulic work. The seats are absolutely protected against wear. The plug is balanced and held in place by pressure when open, and when closed it is locked in the seat by our patent wedging cam. That's what makes Homestead Valves outwear all others.

A quarter turn opens or closes the valve—no waste of time or energy.

A catalogue describing Homestead Valves is yours if you tell us where to send it.

Homestead Valve Mfg. Co.
Works: HOMESTEAD, PA.
P.O. Box 1754, Pittsburg



The SKINNER Valve Re-seating Tool

A Time, Money and Valve Saver which should be in YOUR plant.

Prices f. o. b. Montreal
$\frac{1}{2}$" to 2" - $20.00
$\frac{1}{2}$" to 3" - $30.00
Neatly packed in wooden box.

H. L. Peiler & Co.
380 St. James St.
MONTREAL
69 Adelaide St. E.
TORONTO
McLeod Bldg.
MONCTON, N.B.

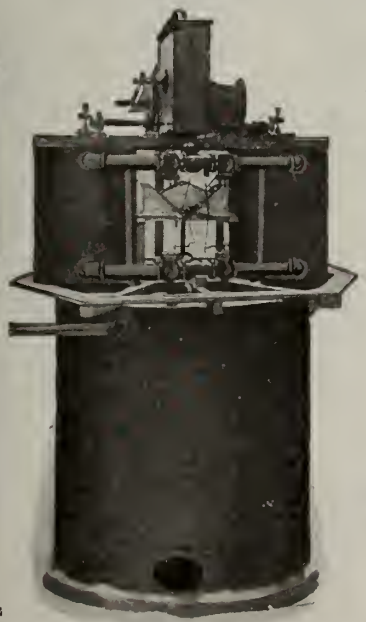
W. E. Skinner, Ltd.
618 Somerset Bldg.
WINNIPEG

LORD'S

WATER PURIFYING CHEMICALS have been the STANDARD for almost 50 years.

LORD'S

WATER PURIFYING APPARATUS will be the STANDARD for the next 50 years.



This is not an idle boast, we know what the average Boiler Room needs.

We know what the shortcomings of the present filters on the market are.

We know the advantages and shortcomings of the boiler compound business through our long association in this line.

The Lord Water Purifying System is designed to overcome all objections.

Send for booklet or send specifications for estimate.

George W. Lord Co.
PHILADELPHIA
SAN FRANCISCO.
Agencies in all principal cities.

WALKER'S ELECTRIC BOILER COMPOUND

Absolutely Eliminates all Losses Caused Through Scaly Boilers.

We do not make claims for this compound. We **guarantee** it to rid your boilers of all scale, and if used regularly will keep your boilers free from all scale without injuring the tubes or pumps in the slightest.

Send us a gallon of feed water. We will analyze it and prepare a compound to meet the conditions of YOUR feed water.

If the compound does not act as we say, it will cost you nothing.

The Electric Boiler Compound Co.
Limited
GUELPH - ONTARIO

Exhaust Steam Is Valuable

If you are wasting it you are wasting money. Harness it at once and make it heat your feed water to a boiling point, and save fuel.

The "OTIS"

TUBULAR FEED WATER HEATER, OIL SEPARATOR AND PURIFIER

spells economy wherever used.

It does its work rapidly and regularly, and is so simple that it cannot get out of order.

The "Otis" extracts all oil from the exhaust. Investigate it at once.

Write for descriptive catalog and prices.

The STEWART HEATER CO.

189 Norfork Ave., Buffalo, N.Y., U.S.A.

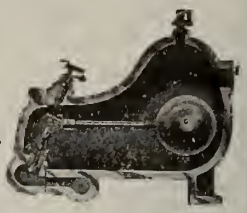
McDANIEL IMPROVED STEEL TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St. MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.
820 Euclid Ave., TORONTO, ONT.

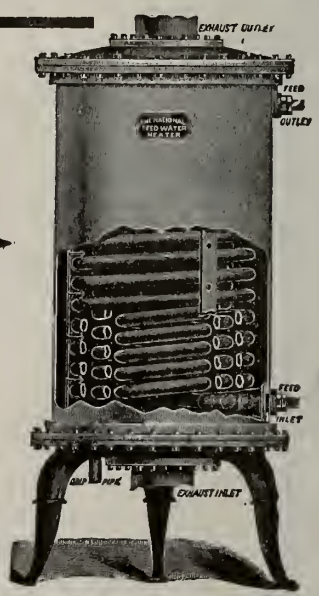
Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto

The National Feed Water Heater



Will Cut Down Your Fuel Bills

There is no use letting your exhaust steam go to waste when you can use it economically by installing this durable and very effective heater.

The initial cost of the National is very small compared with the saving in fuel bills.

It cannot get out of order, being so constructed that the feed water never comes in contact with the shell, and as at no time is the shell subject to boiler pressure, corrosion or leakages are impossible.

The "National" is backed by an ironclad guarantee of good service and our long retained reputation.

Write us for full description and prices to-day.

The National Pipe Bending Company

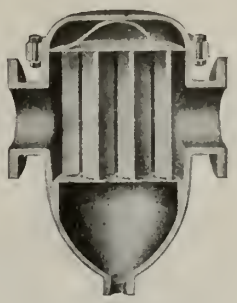
91 Lloyd St., New Haven Conn., U.S.A.

Using Your Exhaust Means Fuel Economy

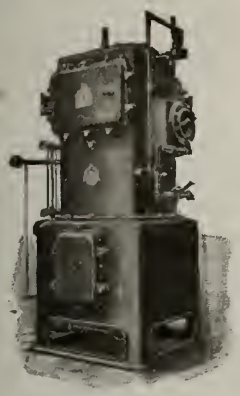
It means that there will be less heating for the coal to do, because the water will be well started on its way to steam by the heat of the exhaust.

Because the Webster Feed Water Heater utilizes the exhaust steam in the right way, it has become known to engineers as one of the prime savers in the plant.

Every Webster Feed Water Heater combines in its construction the highly efficient Webster Oil Separator, thus allowing the condensation to be used for boiler feeding. The water is heated by direct contact, so all the condensation is saved. The Webster Oil Separator makes exhaust steam fit for use in heating boiler feed water, in warming buildings and in various other heating and drying operations.



Webster Standard Horizontal Oil Separator.



Class "EC" Feed Water Heater and Purifier 50 to 300 h.p.

The Webster Heater was the first really successful open heater on the market and the only heater of the "vacuum" type. Upwards of 5000 Webster installations prove that unqualified success has followed them —why don't you investigate?

We'll Send Booklets Free.

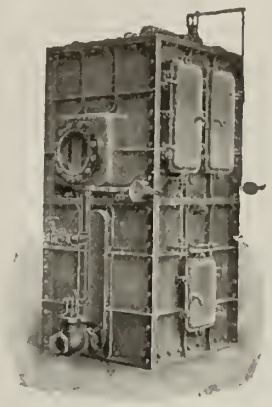
Darling Brothers, Limited

Head Office and Works:

15 Ottawa St., Montreal, Que.

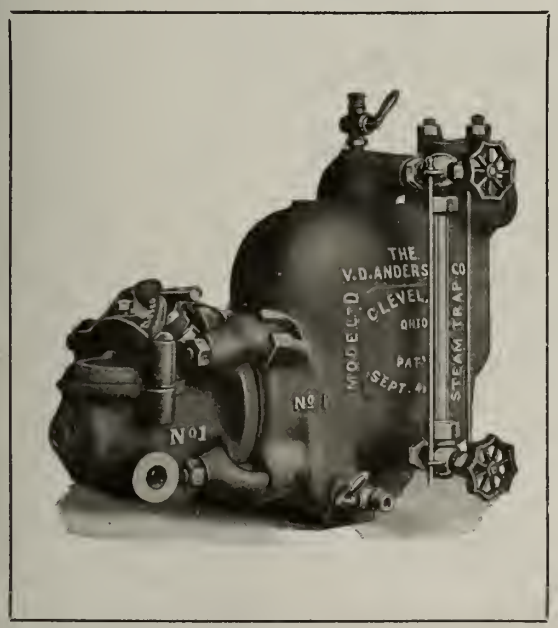
St. John, N.B. Toronto, Ont. Winnipeg, Man.

F. DARLING & CO., Agents, Vancouver, B.C.



Class "EC" Type—1000 to 2,500 h.p.

The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

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Made in seven sizes.

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Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

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McCOLL'S Special Boiler Compounds

or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

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By keeping your boilers free from scale, so that you will get the full heat value of all the coal you burn.

1/16 inch of scale causes a fuel loss of 9% to 12%.

Say 10% of your coal consumption is sheer **waste**—isn't it worthy of your immediate and most serious consideration?

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Being harmless, it is slow in its action on old scale, but is deadly sure.

The cost of using "ECLIPSE" in your boilers cannot be compared with the great saving that results from its use.

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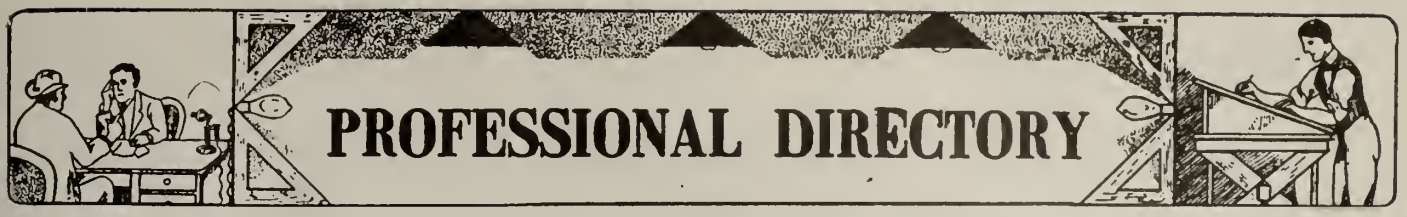

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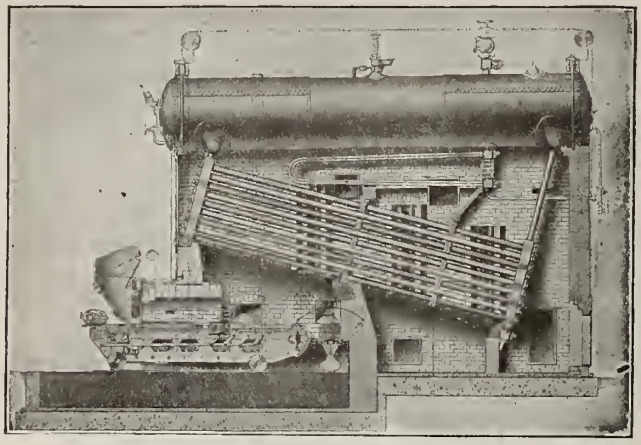

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Hare Eng. Co., Toronto
H. L. Peiler & Co., Montreal

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General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, Ohio
F. J. Schuch, Toronto

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Canada Foundry Co., Ltd., Toronto
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary
Hare Eng. Co., Toronto

Greases.
British Pacific Supply Co., Victoria, B.C
Canadian Fairbanks Co., Ltd., Montreal
Can. Oil Companies Ltd. Toronto
Jos. Dixon Crucible Co., Jersey City
C. C. Snowdon, Calgary

Hangers.
Canadian Bond Hanger & Coupling Co., Alexandria, Ont.
Canadian Fairbanks Co., Ltd., Montreal
Elmira Machinery and Transmission Co., Elmira
General Supply Co of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford

Heaters.
Alberger Condenser Co., New York
Darling Bros., Montreal
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Hare Eng. Co., Toronto
E. Leonard & Sons, London, Ont
H. L. Peiler & Co., Montreal
The Stewart Heater Co., Buffalo, N.Y.

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F. J. Schuch, Toronto

Hose, Steam, Suction and Water.
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J. R. Baxter & Co., Montreal
Dunlop Tire & Rubber Goods Co., Toronto
Garlock Packing Co., Hamilton Ont
Goodyear Tire & Rubber Co., Toronto

Hydraulic Accumulators.
Canada Foundry Co., Ltd., Toronto

Hydraulic Machinery.
The Deming Co. Salem, O

Hydro Extractors.
Jones & Glassco, Montreal

Ice Making Machinery.
Linde British Refrigeration Co., Montreal

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Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton

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Detroit Lubricator Co., Detroit
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Darling Bros., Montreal
Detroit Lubricator Co., Detroit
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati
Manzel Bros. Co., Buffalo, N.Y.

Lubricators, Plain.
Detroit Lubricator Co., Detroit
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, Ohio

Mats.
Dunlop Tire & Rubber Goods Co., Toronto
Goodyear Tire & Rubber Co. of Canada, Toronto

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Babcock & Wilcox, Montreal
Hare Eng. Co., Toronto
Murphy Iron Works, Detroit, Mich.

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Canadian General Electric Co., Ltd. Toronto
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Meters, Water.
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Madison Williams Mfg. Co., Lindsay, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

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Canadian General Electric Co., Ltd., Toronto
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited Montreal

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Canadian Westinghouse Co., Hamilton

Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
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Canada Foundry Co., Ltd., Toronto
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Dunlop Tire & Rubber Goods Co., Toronto
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Quaker City Rubber Co., Philadelphia, Pa
Rhodes Improved Metallic Packing Co., Ltd., Montreal
Steel Mill Packing Co., Windsor, Ont

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Dunlop Tire & Ruhber Goods Co., Toronto
Garlock Packing Co., Hamilton, Can
General Supply Co. of Canada, Ottawa
Goodyear Tire & Rubber Co. of Canada, Toronto
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Asbestos & Rubber Goods Co., Toronto
J. R. Baxter & Co., Montreal
Dunlop Tire & Rubber Goods Co., Toronto
Garlock Packing Co., Hamilton, Can
Canadian H. W. Johns-Manville Co., Ltd, Toronto
General Supply Co. of Canada, Ottawa
Goodyear Tire & Rubber Co. of Canada, Toronto
Quaker City Rubber Co., Philadelhpia, Pa
F. J. Schuch, Toronto

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Dunlop Tire & Rubber Goods Co., Toronto
Garlock Packing Co., Hamilton, Can.
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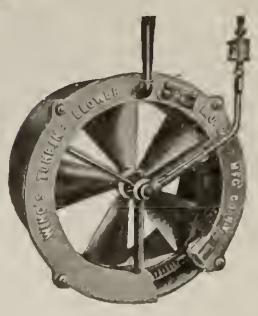

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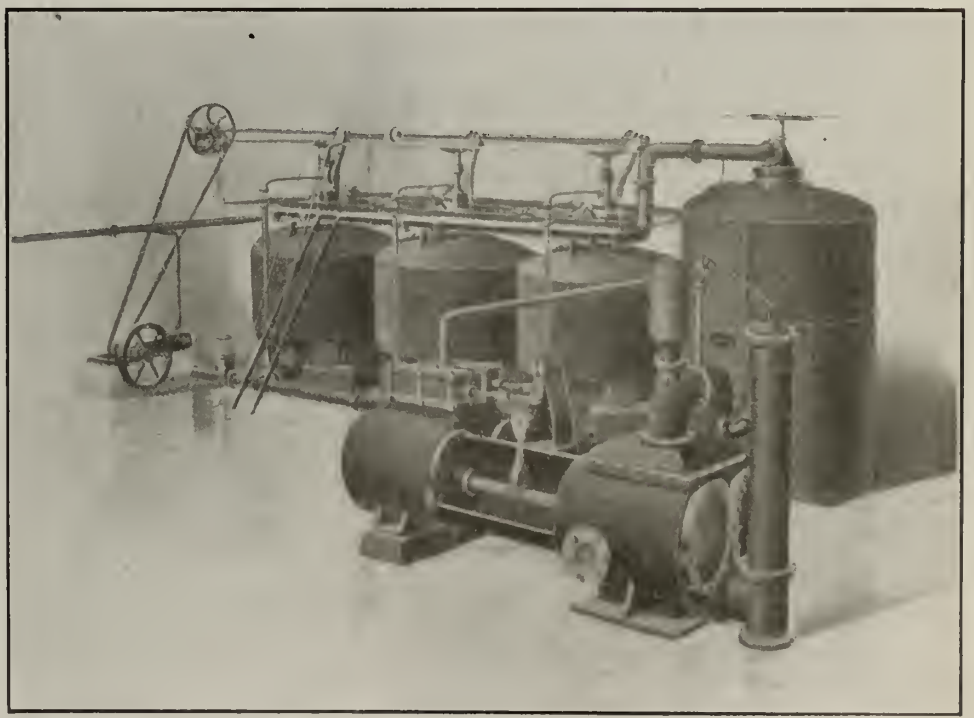

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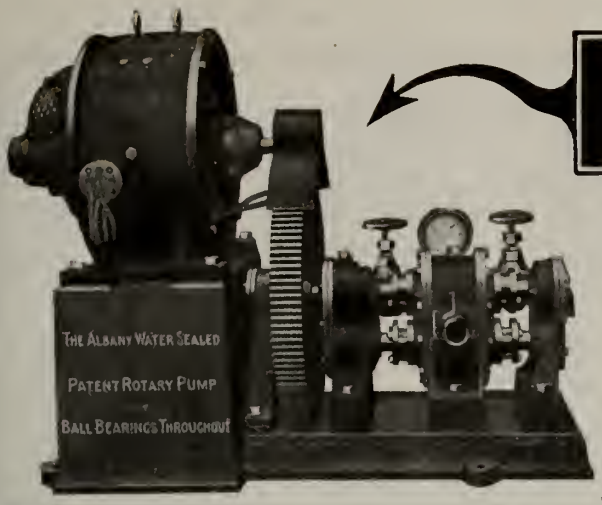
Canadian General Electric Co., Limited Toronto
Canadian Westinghouse Co., Hamilton Ont.

Waste and Wipes.
J. R. Baxter & Co., Montreal
Imperial Waste & Metal Co., Montreal



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Supplied for Belt or any other drive.
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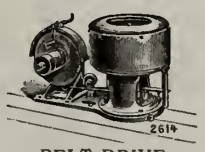
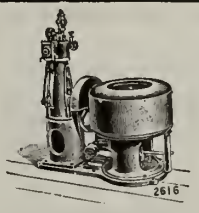
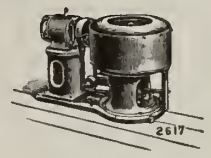


BELT DRIVE



ENGINE DRIVE

WATER DRIVE



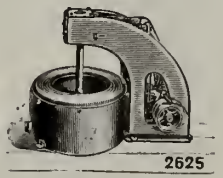
ELECTRIC DRIVE

ELECTRIC DRIVE

HYDRO-EXTRACTORS

To Meet All Requirements

BELT DRIVE



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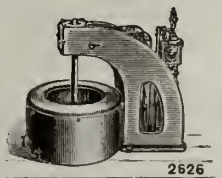


ENGINE DRIVE

ELECTRIC DRIVE

ELECTRIC DRIVE

WATER DRIVE

WATSON, LAIDLAW & CO., LTD.

98 DUNDAS STREET (South), GLASGOW

For further particulars, apply to:—

JONES and GLASSCO, St. Nicholas Building, Montreal.

The advertiser would like to know where you saw his advertisement—tell him.

Water Columns, Gauges.
Eadie-Douglas, Ltd., Montreal
Elliott Co., Pittsburgh, Pa.
The Paul B. Huyette Co., Philadelphia
Lunkenheimer Co., Cincinnati, Ohio

Water Hose.
Goodyear Tire & Rubber Co. of Canada, Toronto
Liberty Mfg. Co., Pittsburgh, Pa.

Water Level Regulators.
Standard Engineering Co., Toronto.

Water-Lifters.
Watson & McDaniel Co., Philadelphia

Water Motors.
Elliott Co., Pittsburgh, Pa.

Water Packing.
Dunlop Tire and Rubber Goods Co., Toronto
General Supply Co. of Canada, Ottawa
Goodyear Tire & Rubber Co. of Canada, Toronto

Water Purifiers, Softeners.
Babcock & Wilcox, Montreal
The Stewart Heater Co., Buffalo, N.Y.

Water Wheels.
Chas. Barber & Sons, Meaford, Ont.

Whistles, Plain or Chime.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.

Wire, Bare and Insulated.
Canadian General Electric Co., Limited Toronto
Eugene F. Phillips Electrical Works, Ltd., Montreal

Wire, Magnet and Trolley.
Canadian General Electric Co., Limited Toronto
Eugene F. Phillips Electrical Works Ltd., Montreal

Wire, Railway Feeder and Trolley.
Canadian General Electric Co., Limited Toronto
Eugene F. Phillips Electrical Works, Ltd., Montreal

Engineers, Machinists and Draughtsmen

ARTISTS AND DRAUGHTSMENS MATERIALS
THE ART METROPOLE LIMITED
149 YONGE STREET TORONTO

Will find a full and select line of Drawing Instruments and Supplies at the leading house in Canada

THE ART METROPOLE, Limited
149 YONGE ST., TORONTO

Power Transmission Equipment and Machinery

MECHANICAL MATERIAL CONVEYORS, INDUSTRIAL RAILWAYS.
Including Rails, Switches, Frogs, Cars, etc.,
—FOR—
MILLS, FACTORIES, MINES, GRAIN ELEVATORS

We carry in Stock a complete line of Transmission Equipment as below.

Iron Pulleys, Solid and Split
Sprockets,
Bearings,
Gears—Spur, Bevel, Mitre,
Shafting,
Couplings,
Post Hangers,
Post Boxes,
Take-up Boxes,
Boots,
Boot Pans,
Shaft Hangers,
Friction Clutches,
Belting,
Belt Tighteners,
Buckets,
Sprocket Chain Attachments,
Car Movers and Pullers,
Iron Work for Dumps,
Spiral Conveyors.

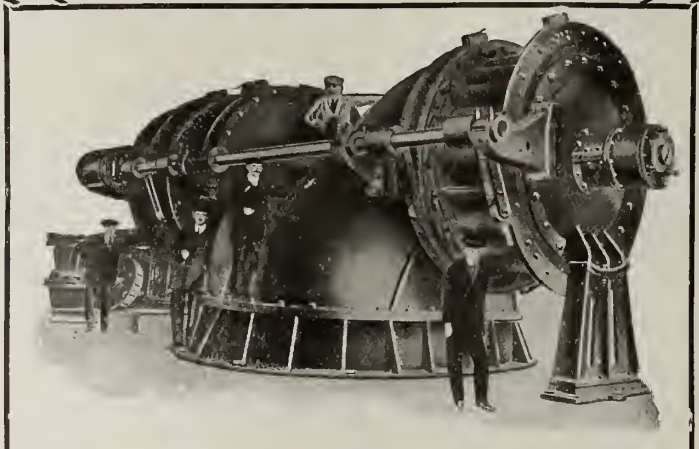
Equipment and Supplies for 50 Grain Elevators carried in stock at all times.
SEND US YOUR SPECIFICATIONS.

THE MANITOBA BRIDGE AND IRON WORKS, LIMITED
WINNIPEG, MAN.

WATER TURBINES
—AND—
GOVERNORS

All Sizes

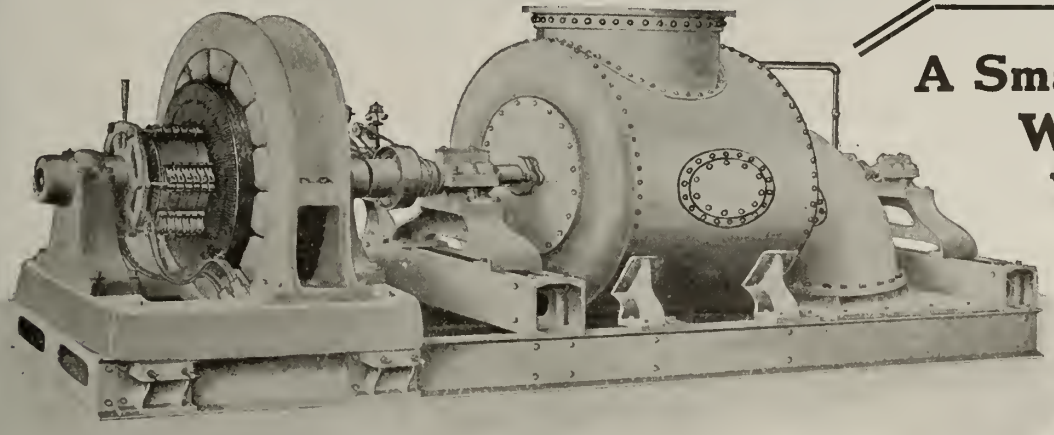
Maximum Efficiency



All Heads

Ideal Control

ASK FOR PARTICULARS FROM
THE CANADIAN BOVING CO., LTD.
164 BAY STREET, TORONTO.
Branch Office for British Columbia, 427 Seymour St., Vancouver



A Small Stream Will Create Wonderful Power

If you are located near one investigate

The "TRIUMPH" Turbine Wheel

It will develop power to meet your requirements at an enormous saving. Cut illustrates one of our wheels in Steel Flume, the shaft being connected direct to dynamo beside the wheel.

There is absolutely no vibration in this setting as the whole outfit is mounted on one base, made of I beams, and the governor mounted on same frame regulates the speed perfectly.

Write us to-day for full details.

Madison-Williams Mfg. Co., Ltd., Lindsay, Ont

The advertiser would like to know where you saw his advertisement—tell him.

There Is a Place In Your Plant For a Davis Pressure Regulator

And the longer you put off getting it the more steam you are using that might just as well be saved.

No matter what your boiler pressure may be, by the use of this valve, you can get any reduced pressure that you may require for heating, drying, cooking, running auxiliary apparatus or any other purpose.

Suppose you carry 125 pounds pressure on your boilers. It is a positive waste of steam to use that same high pressure when 75,—50 or any lower pressure would do the work just as well or perhaps better. By reducing the pressure from 125 to 50 pounds you save over 50 per cent. in steam consumption and that makes the cost of the valve insignificant when compared with the ultimate saving effected by its use.

The Davis Pressure Regulator

was the first successful reducing valve made in America and its equal for efficient, dependable service has never been produced.

Its principle is the balancing of pressure by direct weight, and by changing the weights it can be set to deliver any desired pressure. It is simple in construction, having no diaphragm, packing, springs, auxiliary valve or delicate parts to get out of order. It is unconditionally guaranteed.

Let us send you a Davis Regulator on approval. We will take all risk of its failure to please you in every respect.

Jobbers and dealers everywhere sell Davis Valve Specialties.

Davis Pressure Regulators Save Steam

G. M. Davis Regulator Co.

Established 1875

434 Milwaukee Ave., Chicago

Manufacturers of the Davis Back Pressure Valve, Steam Trap, Stop and Check Valve, Float Valve, Pump Governor and other Specialties.

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The advertiser would like to know where you saw his advertisement—tell him.

Westinghouse

Self-Starting Synchronous Motor-Generator Sets

Westinghouse Synchronous Motor-Generator Set with Direct-Connected Exciter.
Motor, 1000 Kva. Generator, 400 Kw.

WHERE it is desirable to install an alternating-current motor-generator set, it is often advantageous to drive it with a synchronous motor.

Such a motor, in addition to driving the set, can be so arranged as to correct the power factor of the system that serves it, irrespective of whether the natural power factor of the system is leading or lagging.

The Best Service always follows the introduction of Westinghouse Apparatus.

Canadian Westinghouse Co., Limited, Hamilton, Ont.

Toronto	Montreal	Halifax	Winnipeg	Calgary	Vancouver
Traders Bank Bldg.	52 Victoria Square	Telephone Bldg.	158 Portage Ave. E.	311 8th Ave. W.	Bank of Ottawa Bldg.

J.M.T. Guaranteed

TRADE MARK J.M.T. REGISTERED A GUARANTEE OF QUALITY

INJECTORS

No matter what your requirements may be, Morrison's J.M.T. Improved Injectors will meet them squarely, and give the highest satisfaction.

Every Injector is carefully tested before leaving the factory, and **guaranteed PERFECT** in every respect.

Operate at a low pressure of 20 lbs., and work perfectly up to a pressure of 220 lbs. In fact, they cover a range of pressures greater than that obtained by any other makes.

Capacities are based upon actual tests, and can be reduced by simply throttling the water supply.

Investigate the "J.M.T." Improved Injector at once. It contains the qualities that prevent worry, expense and loss of time through unnecessary attention.

Write for full details to-day.

The James Morrison Brass Mfg. Co., Ltd.

93-97 Adelaide Street West, TORONTO

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-149 University Ave. LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. V. Publication Office, Toronto—May, 1912 No. 5

TRADE PENBERTHY MARK

HIGH GRADE STEAM SPECIALTIES

are specified by all the leading Engineers throughout the country because

They are EFFICIENT, ECONOMICAL and RELIABLE

This illustration shows the best method of priming centrifugal pumps. A Penberthy XL-96 Ejector is attached to top of pump as shown: this when operated produces a partial vacuum in the pump and its suction pipe, permitting the water to rise into the pump. When the Ejector is connected with the suction attached to pump, it can be operated with air, steam or water, preferably air, because of its exhausting larger quantities in a shorter time.

"The Liquid Lifter"

Simplest in Construction. Easiest Operated.

For Lifting or Elevating Liquids.

For Priming Centrifugal Pumps.

For Exhausting Air or Gas from Tanks, Pipes, etc.

THEY ALWAYS WORK

MANUFACTURED BY

Penberthy Injector Co., Limited - - Windsor, Ontario, Canada

Showing Ejector placed in position for high elevation of water. It will lift 22 to 25 feet and elevate 25 to 100 feet on from 30 to 100 lbs. with smaller steam consumption than any other syphon or jet pump on the market.

EVERY DAY SOME ENGINEER IS TEMPTED BY THE RANK IMITATIONS THAT FLOOD THE MARKET. INSIST UPON TRAVELLING THE RAINBOW ROUTE. GENUINE RAINBOW WITH THE TRADE MARK RAINBOW RAINBOW RAINBOW NEVER BLOWS OUT.

FOR SALE EVERYWHERE

THE PEERLESS BRAND OF PUMP VALVES ARE MADE TO MEET ALL REQUIREMENTS. WRITE US ABOUT YOUR PUMP VALVE TROUBLES AND WE WILL GUARANTEE TO SOLVE THE PROBLEM FOR YOU.

MANUFACTURED EXCLUSIVELY BY

PEERLESS RUBBER MANUFACTURING COMPANY

16 WARREN ST., NEW YORK

H. D. EDWARDS & CO.

DETROIT - MICH.

Sole Agents and Distributers for the Dominion of Canada

Steel Plate Work

WE have made a success of building Steel Plate Work by specializing in it.

The 1911 extensions to our Shops have placed us in a better position than ever before to do this work. Our facilities in every department have materially increased—we have the men, the equipment, and the experience to turn out this special work as it should be.

We design and build any kind, any size, of:—

CONVEYORS	STEEL TANKS
SMOKE BREECHINGS	STORAGE BINS
STEEL STACKS	COOKERS and DIGESTERS
SPARK ARRESTERS	STEEL GAS MAINS
STEEL BUCKETS	REFUSE BURNERS

ELEVATORS

Before you buy anything along these lines send us your sketch and let us quote.

The Waterous Engine Works Co., Limited

Brantford, Canada

The advertiser would like to know where you saw his advertisement—tell him.

BULL RINGS

PERHAPS you have not thought of Magnolia Metal in connection with Bull Rings. It seems to be just the thing. It is also good for piston and stem rod packing.

MOBILE LIGHT AND RAILROAD COMPANY

Mobile, Ala., January 12th, 1912.

GENTLEMEN—In answer to your inquiry of January 2nd, will state that the Magnolia Metal put in our Bull Rings two years ago is giving perfect satisfaction. The metal has worn about 1/32 in. on the bottom, in that time. The ring is 58 inches in diameter and 11 inches of bearing surface. Two days were used in the job of removing the ring, preparing it for filling and turning it in a lathe to fit cylinder after it was poured. If the above is of any use to you, you may use it any way you like.

Respectfully,

C. MANKER,
Engineer Power Station.

The method employed in applying Magnolia as described by Mr. Manker will be sent to anyone desiring the information.

SPECIAL OFFER.

PRACTICAL ENGINEER POCKET BOOK: 680 pages, over 2000 subjects. Price 40c. postpaid. We do not aim to make a profit on these books. We buy them in large quantities as an advertising medium and give Engineers the benefit of low price. They are highly spoken of by Engineers. **Address Montreal Office.**

Sold by leading dealers everywhere or by

Magnolia Metal Co.

225 St. Ambroise Street, Montreal

New York Chicago

Crushing Machinery

Crushers, Crushing Rolls,
Fine Crushers
and Accessories.

Complete Crushing
and
Screening Plants,
including
Power Equipment.

Write for Catalog.

The Jenckes Machine Co., Limited

General Offices: Sherbrooke, Que.

Works: Sherbrooke, Que. St. Catharines, Ont.

Sales Offices:—Sherbrooke, St. Catharines, Montreal, Cobalt, So. Porcupine, Vancouver, Nelson.

TIMES CHANGE

So does the plant.

IF an engineer does not keep up-to-date, how long does it take to look elsewhere for a position?

IF the steam plant of any company or corporation is not up-to-date, how long does it take to find a leak?

These are not conundrums, but facts which confront us all.

The Heat and Pressure Control Co.

are experts in steam plant economics and are anxious to demonstrate what their appliances can do.

Don't fail to consult if you wish to be up-to-date in money-saving appliances.

WRITE OR CALL

603 Kent Building - - Toronto

THE
CANADIAN CASUALTY
AND
BOILER INSURANCE
COMPANY

SPECIALTY:

Boiler Inspecting, Reporting,
Insurance, Evaporation Tests

CONTINENTAL LIFE BUILDING
TORONTO

J. O. B. Latour
Chief Engineer.

John J. Durance,
Manager.

Phone Main 6941.

The advertiser would like to know where you saw his advertisement—tell him.

Two Great Needs Filled

Goodyear Sheet Packing for High or Low Pressure
Magnet High-Pressure Gasket Tubing

After months of painstaking experiment we have perfected Sheet Packing and high-pressure *Gasket Tubing* that forever *do away* with the disappointment, trouble and expense caused consumers by the many cheap and worthless grades that have been placed on the market.

Magnet Sheet Packing

Made of the celebrated Magnet compound, this packing is totally ***unaffected by heat, oil, liquor (ammonia), alkali, or by expansion or contraction.***

It is suitable for high or low pressure uses, particularly high, because of its heat-resisting properties. It neither becomes hard nor brittle. Retains its tough, elastic efficiency for months.

Magnet Sheet Packing won't *blow out.* It makes a tight joint that stays tight under air, hot or cold water or strain pressure.

Meets every requirement.

No engine room, locomotive, steamboat or machine shop is properly equipped without a roll of this great emergency packing.

GOODYEAR

Magnet High-Pressure Gasket Tubing

Made also from the celebrated Magnet Compound. Forms a tight joint no matter how rough the surface may be—and it is

Pressure-Proof

Magnet Gasket Tubing can't blow out. Like Magnet Sheeting, it successfully resists any degree of steam heat and it maintains its elasticity.

Cut to Fit

One of the big advantages of Magnet Gasket Tubing is that it may be cut any length to fit any size manhole or handhole, plate or pipe flange. Cut ends joined together with rubber core, making *continuous gasket.* Put up in convenient boxes with rubber core and tape.

If you need sheet packing or gasket tubing, grasp this opportunity. The Goodyear trade-mark stands for reduced first cost and economy all along the line. It stands for the same quality workmanship that underlies the success of the Goodyear Tire & Rubber Company, Akron, Ohio, one of the best known and most experienced manufacturers of rubber goods in the world. Our sales of the last four months fifty per cent. greater than those of last year. Defective goods returned only $23.93.

Write for Our Catalog To-night

The Goodyear Tire & Rubber Company of Canada, Ltd.

General Offices—Toronto Factory—Bowmanville, Ont.

Write Our Nearest Branch

BRANCHES: Montreal—Winnipeg—St. John, N.B.—Vancouver—Calgary
Victoria, B.C., 855 Fort Street; Regina, Saskatchewan, 2317-2318 South Railway Street; Hamilton, Ont., 127 King Street West

16

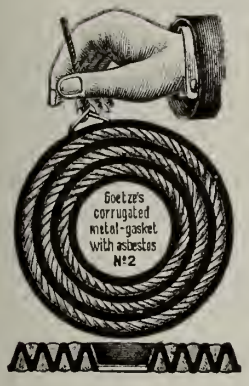
GOETZE'S VALVE GASKETS SAVE TROUBLE AND MONEY

THEY ARE FOR VALVES OF THE JENKINS TYPE
AND ARE MADE OF COPPER AND ASBESTOS

One Goetze's Valve Gasket will outlast six rubber discs, because it will not crack and go to pieces as rubber does. That's why Goetze's Valve Gaskets are cheapest from beginning to end.

Order your new valves fitted with Goetze's Valve Gaskets and have no more trouble with leaks. Use Goetze's Valve Gaskets to give your old valves a new lease of life. Only be sure you get *Goetze's.*

That Joint That Gives You So Much Trouble Can Be Made *Tight*



To put a gasket on the least troublesome flange joint in your plant is no real test of the value of that gasket. Put it on the *worst* joint, the one that is always giving you trouble, and you'll find out whether it is any good for your purpose or not.

We tell you that you can put a complete stop to all trouble due to leaky flange joints, that you can make that joint which gives you so much trouble absolutely tight

By Using Goetze's No. 2 Gaskets

And we are willing to prove it to you by shipping you any quantity on *90 days' trial*—no charge if they do not make tight joints and *hold* them tight under all pressures and temperatures. Try them. Write us to-day what sizes and quantities to ship. Remember, they do not cost you a cent unless they do the work. And be sure to ask for a copy of our Illustrated Catalog of Packings for all Power Plant Purposes.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

St. John, N.B.

BRANCHES AT

MONTREAL
163 Esplanade Ave.

WINNIPEG
C. E. Chown, 147 Bannatyne Ave.

VANCOUVER
A. O. Campbell, 1069 Hamilton St.

MANUFACTURED BY

Goetze Gasket & Packing Co.

NEW BRUNSWICK, N.J.

The advertiser would like to know where you saw his advertisement—tell him.

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY

The Question of Your Daughter's Education

is a matter of the amount of the wages you can command. The engineer who earns most is the engineer with the greatest knowledge of his profession.

Our Blue Book of "Questions and Answers to Engineers' License Examinations" will help you earn more. The book will be sent FREE, if you comply with the simple requirements stated below.

How to get the Hand-book FREE

Fill out the Coupon and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and look at Daniels' P.P.P. Packing.

YOUR NAME. .....
ADDRESS .....
EMPLOYED BY .....
ADDRESS .....
HORSEPOWER OF ENGINE .....
KIND OF ROD PACKING USED .....
DO YOU USE EBONITE SHEET PACKING? .....
BUYER'S NAME .....
DEALER'S NAME .....
ADDRESS .....
..... Series 24-E

If your dealer doesn't carry P.P.P., we will write telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

How Much Power Does Your Packing Waste?

Perhaps you don't know how much power rod packing can waste. Neither did we, until we had the leading Mechanical Engineer of the country and a corps of assistants make a long series of tests of engines under actual working conditions. These tests proved that "solid" packings waste from $100.00 to $500.00 worth of power yearly.

Another thing we found out was that this unnecessary loss can be saved by using

Daniels'
P. P. P.
Rod Packing

This means a big money saving for the "boss," and a big saving of work for you, Mr. Engineer. To prove these statements, all you need do is to try THREE rings of P.P.P. One packing will last for months—likely a whole year. Send for a sample of the GENUINE Daniels' P.P.P. Rod Packing, or see it at the dealers', when you call for your Blue Book.

THREE STYLES—"Regular," "Special" and "Marine." All styles are furnished in Coil, Spiral and Ring forms.

FREE To Users of P.P.P.

If you are a user of P.P.P., fill out the coupon and mail it to us. We will send the Engineers' Examination Book to your dealer (or one we name) who will hand it to you when you call at his store and look at Daniels' EBONITE Sheet Packing.

To better protect P.P.P. users against imitations, we have adopted a red "D" with a diagonal line across it.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

PHILADELPHIA, PA., U.S.A.

YEARS OF EXPERIENCE

Convinces others of the **Superior Qualities** of Garlock Packings.

You will save much by taking a short cut and using them **now.**

TRADE THE GARLOCK PACKING CO. HAMILTON, CANADA. MARK

This design is the registered Garlock Trade-Mark, and stands for the highest standards of quality and service possible to obtain in the manufacture of Packings.

—— LOOK FOR IT ——

The Garlock Packing Co.

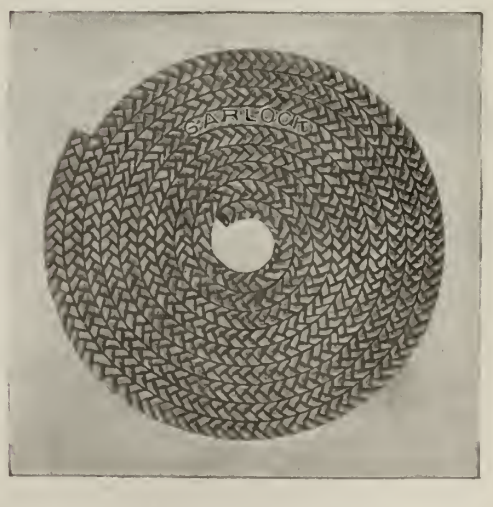
Head Office and Factory:
HAMILTON - ONTARIO

Branches:
Montreal Toronto Winnipeg

"Pioneers in the Packing Business."

Garlock Low Pressure Diagonal

Garlock Gum Core.

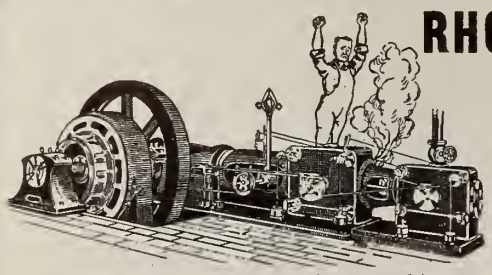


Garlock Square Flax

Write for Catalogue showing "Packings for Every Purpose."

The advertiser would like to know where you saw his advertisement—tell him.

RHODES IMPROVED METALLIC PACKING

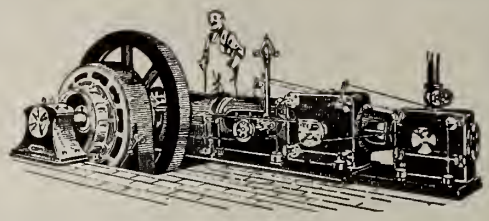


This was BEFORE he used our packing.

THE PACKING THAT PACKS

A trial will convince you.

Beware of Imitations.



This is AFTER he installed our packing.

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited

55 St. Francois Xavier Street, - - - MONTREAL

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

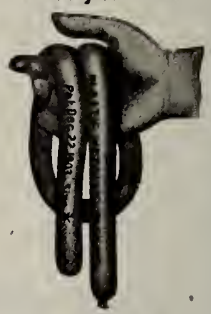
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

Practically Frictionless

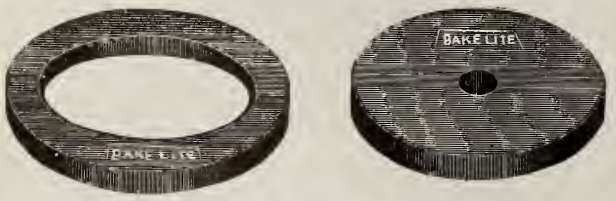


Sold on APPROVAL

These are the telling points about

Bakelite

Valve Discs



They will not leak under high temperature, excessive pressure or when used in acids or other special liquids. Neither cold water, dry or superheated steam has the least effect upon them. BAKELITE Discs are a gas-tight fit.

BAKELITE is a successful substitute for expensive metal. Its structure is fibrous, giving strength and hardness. It can be reground and refaced, always retaining a uniform surface. It cannot be injured, except by accident or friction.

Remember Bakelite PUMP VALVES do not warm with changes of temperature.

Order your valves fitted with Bakelite Valve Discs and stop that perpetual annoyance and expense caused by leaking valves. Depend upon it, Bakelite Valve Discs will not leak.

WRITE FOR PRICES OR ASK YOUR DEALER.

PLASTICS, Limited, - Van Horne St., TORONTO

Sole Agents for Alberta, Saskatchewan and Manitoba.
Bakelite Valve Discs and Pump Valves.
GENERAL SUPPLY CO. of CANADA, LIMITED, Winnipeg.
Head Office, Ottawa. Branches: Winnipeg and Toronto.

A STEEL GASKET

For Water Tube Boilers

The (Double R.-R.) Gasket

Made In Canada

We are the Sole Manufacturers In Canada of the Steel Asbestos Gaskets.

Mr. Engineer!

No more plates to clean, there is nothing in a steel gasket to melt or burn, and stick to the plates, just a steel shell filled with an asbestos cord. Cheaper and better than any other Gasket on the market.

Write for free sample, naming the make of boiler.

CANADIAN GASKET CO.

BRIDGEBURG, ONTARIO

Corrugated Copper Gaskets of all kinds.

The advertiser would like to know where you saw his advertisement—tell him.

3000 DEGREES of HEAT cannot fuse this FIRE-BRICK CEMENT

J-M High Temperature Cement No. 30, used as a binding material in fire-brick structures, will absolutely prevent their collapse when subjected to excessive heat.

It is especially recommended for setting up fire-brick and lining brass, iron, oil-burning, tilting and rotary furnaces, cupolas and assayers' crucibles; also for setting up and facing side walls and bridge walls of boilers, furnaces, etc.

J-M High Temperature Cement

saves at least 50 per cent. in maintenance cost and is far superior to fire-clay and similar materials which fuse under extreme heat, run and open up joints, causing leakage and disintegration of the structure.

J-M Brickline Cement, used as a coating on the brick surface, closes up the pores and forms a glaze which prevents clinkers from adhering.

Write our nearest branch to-day, stating class of furnace, temperature and trouble you experience, and we will prescribe the proper remedy.

THE CANADIAN H. W. JOHNS-MANVILLE CO., Limited

Manufacturers of Asbestos and Magnesia Products

TRADE ASBESTOS MARK

Asbestos Roofings, Packings, Electrical Supplies, Etc.

TORONTO, ONT. MONTREAL, QUE. WINNIPEG, MAN. VANCOUVER, B.C.

1400

The ASBESTOS & RUBBER GOODS CO.

TORONTO, Ont.
141 King Street East,

MONTREAL, Que.
43 St. Francois Xavier Street,

L. R. & B. PUMP VALVES

Give better service than any other, and last longer.

Brass Casing prevents ports from forcing through.

Only best quality of material is used, and as wear takes place the rubber can be replaced until brass casing is reached, thereby giving full use of all the rubber.

It only needs a trial to convince you.

We also carry a full stock of all other engineers' supplies.

Write us before placing your orders.

The advertiser would like to know where you saw his advertisement—tell him.

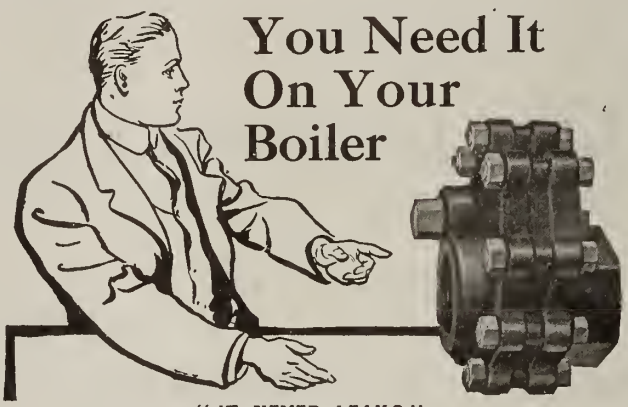
A SELF-MADE REPUTATION

is that of the "EVERLASTING" BLOW-OFF VALVE

That is why you are not taking any chances when you buy it. It has made good on thousands of jobs just like yours. One firm has 26 of them, and they gave it a year's trial. It stood the test. It's a "standard."

In use by

POWER PLANTS
RAILROADS
STEAMBOATS
GOVERNMENTS



"IT NEVER LEAKS"

Made in

IRON BODY
SEMI BRASS
SOLID BRASS
ALL IRON

Engineering Specialties Company

1080 King Street West — **TORONTO, ONTARIO**

H. L. PEILER & CO., 380 St. James Street, Montreal

AGENTS:
THE A. R. WILLIAMS MACH. CO. OF ST. JOHN, N.B., LTD., St. John, N.B.

P. D. McLAREN, LIMITED, Calgary, Alta.

6" Flanged End
Kerr Gate Valve

When next you order an Iron Body Gate Valve, specify

Kerr's New Pattern

LIKE THIS ILLUSTRATION

We want you to see and try what we know to be the strongest and best made Valve on the market for Standard pressure. Every Valve tested 300 pounds Hydraulic Pressure.

THE KERR ENGINE CO., Limited

WALKERVILLE, ONTARIO.

The advertiser would like to know where you saw his advertisement—tell him.

NELSON Bronze Globe Valves

TRADE-MARK REGISTERED

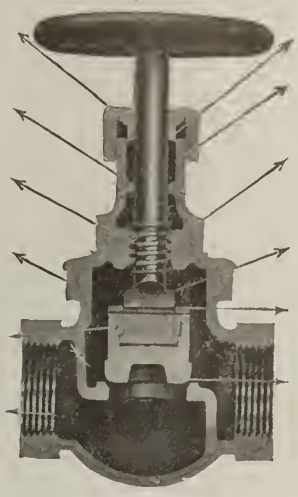
Showing the same valve with rubber disc.

Stem has bearing at three points in the bonnet, steadying it centrally, causing the discs to remain at all times CENTRAL with the seat.

Bonnet screwed on the outside of the body, fortifying the body against internal strain.

This regrinding disc can be replaced easily with the rubber disc shown in the valve on the left, or with the copper disc shown in valve on the right, all being renewable and interchangeable on the SAME STEM AND IN THE SAME VALVE.

See the wide hexagons and the long threads.



Gland Packed.

Large Packing Box.

All threads engaged with bonnet when valve is closed, when you apply the most pressure and NEED THE MOST STRENGTH.

Chamfered shoulder makes tight joint with recess in bonnet when valve is wide open, so you can repack valve when under pressure.

To regrind, a nail through this hole prevents the disc from revolving on the stem.

Regrinding disc radial where it makes contact with the seat, preventing cutting of both disc and seat. (Cut shows the valve slightly open.)

Showing the same valve with copper disc.

For 175 pounds working pressure, each valve tested to 500 pounds.

All **NELSON** Valves are tested to more than double the pressure they will be subjected to in actual service. The test is so carefully made that a weak or defective valve cannot get out of our shops.

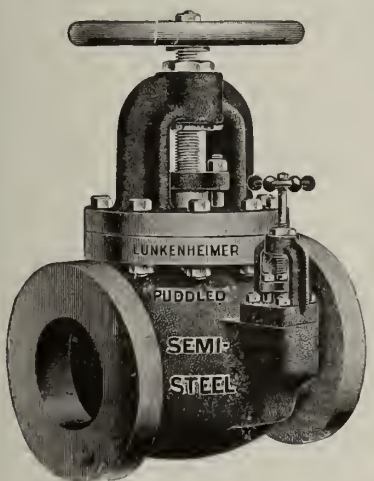
Nelson Valve Company, Philadelphia

MONTREAL 12-14 University St. | NEW YORK 30 Church St. | CHICAGO 17 West Kinzie St | SAN FRANCISCO 22 Battery St. | PITTSBURGH 517 Liberty Ave

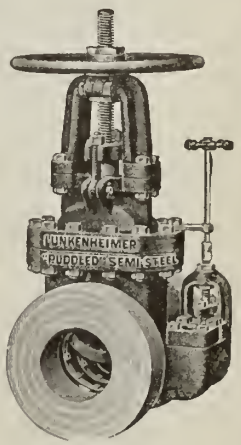
MINNEAPOLIS 625 Andrus Bldg. | BUTTE 56 E. Broadway

We make nothing but valves, but we make all sizes, for any pressure, for every purpose. Gates, Globes, Angles, Checks and Blow-offs. High-grade valves exclusively. No competition stuff whatever.

LUNKENHEIMER "PUDDLED" SEMI-STEEL VALVES



GLOBE VALVE



GATE VALVE

SWING CHECK VALVE

HORIZONTAL CHECK VALVE

These valves are particularly adapted for high pressures and superheated steam, and are in use, giving perfect satisfaction, in a large number of high pressure power plants.

The **"Puddled" Semi-steel** as used in Lunkenheimer Valves is an extremely high grade iron and steel alloy of very close grain and great strength, the tensile strength per square inch being 35,000 pounds.

All parts subjected to wear are renewable, making the valves practically indestructible.

The line includes Globe, Angle, Cross, Gate, Non-return Safety Boiler Stop and Check Valves, guaranteed for **working pressures up to 250 pounds per square inch**, and to suit various conditions of superheat and meet the specifications of engineers who differ as to the material used for the trimmings, Lunkenheimer "Puddled" Semi-steel Valves are made in two combinations.

For extreme conditions of superheat and strain, these valves can be had of **Cast Steel**, the tensile strength of which is about 80,000 pounds per square inch. They can also be had made of a high grade Gun Iron, having a tensile strength of 25,000 pounds per square inch.

Specify and insist upon securing genuine **Lunkenheimer make.** Do not accept substitutes—they are never as good as the genuine.

"MOST supply houses sell them-yours CAN-if they DONT or WONT tell US"

Write for a copy of our 1912 catalogue.

THE LUNKENHEIMER COMPANY

Largest Manufacturers of High Grade Engineering Specialties in the World.

General Offices and Works: CINCINNATI, OHIO, U.S.A.

New York 64-68 Fulton St. | Chicago 186 N. Dearborn St. | Boston 138 High St. | London, S.E. 35 Great Dover St.

The advertiser would like to know where you saw his advertisement—tell him.

TRADE JENKINS MARK
Jenkins Bros.

TRADE JENKINS MARK
Jenkins Bros.

"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

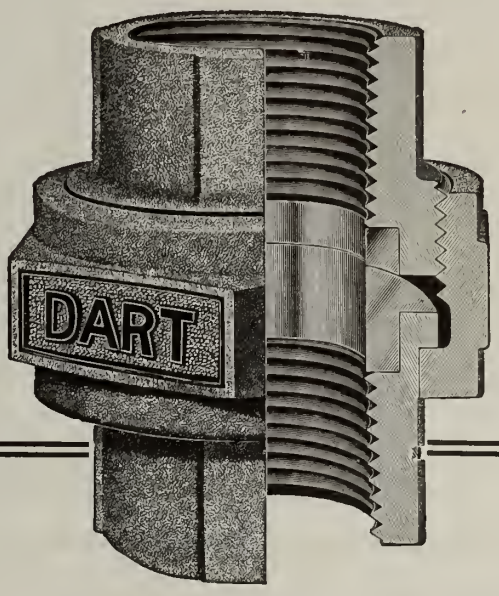
The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for ***genuine*** "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL

UNION PIPE COUPLINGS

That Will Not Leak



BRONZE to BRONZE JOINT

Dart unions connect pipe in such a manner that the joint will never leak. They are easily connected, for the ball shaped joint finds its own seat and makes a fast joint either in or out of line.

The joint is bronze against bronze—metal that will not rust or corrode—so that the union is always serviceable and may be connected time after time.

They are made to stand severe service and are not affected by contraction, expansion or vibration.

Every Dart union is guaranteed 2 for 1 to give absolute satisfaction. Get Dart unions from your jobber; their use will fully demonstrate their worth to you. The Trade Mark is cast on every Dart.

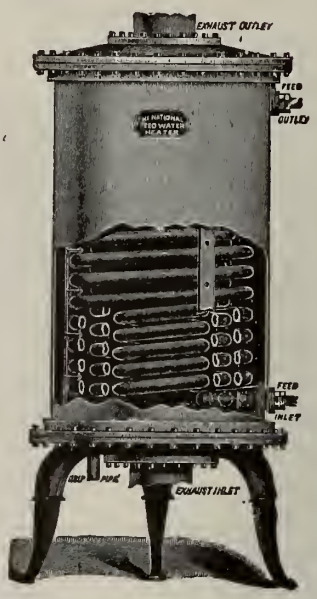
The unions that saves money for every user.

Dart Union Co., Limited, Toronto, Ont.

A Boiler Room Necessity

If you are not using a Feed Water Heater you do not realize their great importance in the boiler room. Investigate the

"NATIONAL" FEED-WATER HEATER



at once—make it a point to write us now. Do not delay for delays of this sort are very costly.

The price of the "NATIONAL" is very moderate, when the economy it effects is considered. Its working parts are simple, practical and very durable.

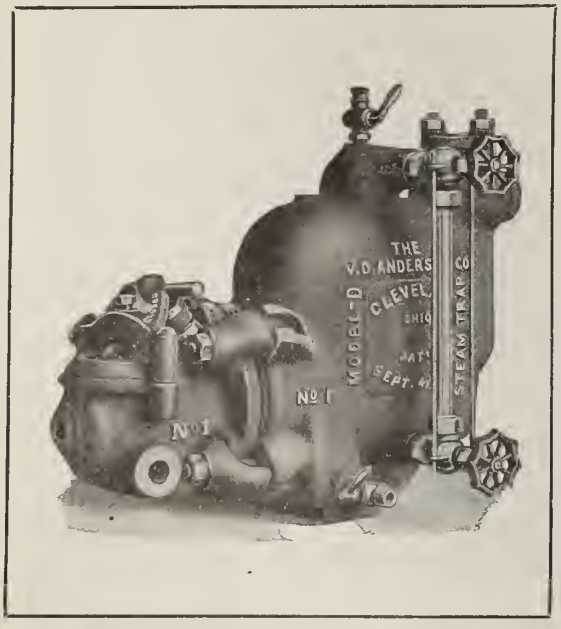
Write for our free booklet on Feed Water Heating. It cannot fail to interest you.

The National Pipe Bending Co.

91 Lloyd Street

NEW HAVEN, CONN., U.S.A.

The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

The SKINNER Valve Re-seating Tool

A Time, Money and Valve Saver which should be in YOUR plant.

Prices f. o. b. Montreal
½" to 2" - $20.00
½" to 3" - $30.00
Neatly packed in wooden box.

H. L. Peiler & Co.
380 St. James St.
MONTREAL
69 Adelaide St. E.
TORONTO
McLeod Bldg.
MONCTON, N.B.

W. E. Skinner, Ltd.
618 Somerset Bldg.
WINNIPEG

The Utmost in

GAUGE GLASS QUALITY

Bishops ADAMANT

defies the highest Steam Pressures and all variations of temperature.

ADAMANT GLASSES

have gained a reputation of good service and reliability.

Write us for full particulars ***to-day***.

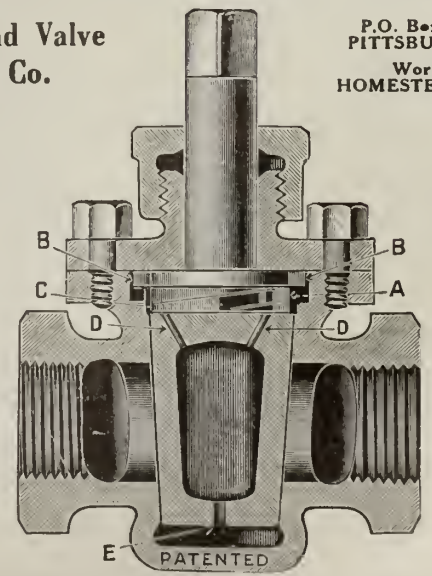
J. R. Baxter & Co.
Mill Supplies MONTREAL

Homestead Valves are Quality Valves

A qua ter turn—just a slight twist of the wrist—closes or locks the *Homestead*. A quarter turn back opens it wide. It being free from friction, long life and the maximum of service is assured. This valve cannot jar open—when you lock it, it stays locked. The seats are perfectly protected from wear both when closed and when pressure is passing through them. *Every valve* is hand ground to a perfect fit and tested before shipment. They are absolutely leak-proof under any steam, air or hydraulic pressure. *Homestead Valves* are giving satisfaction throughout the entire world, under the most severe conditions. Just try one if the valves you are now using are weak in some essential point. The many superior points of *Homestead* Straightway, Three-way and Four-way Valves fully described in our catalog. Have a copy?

Homestead Valve Mfg. Co.

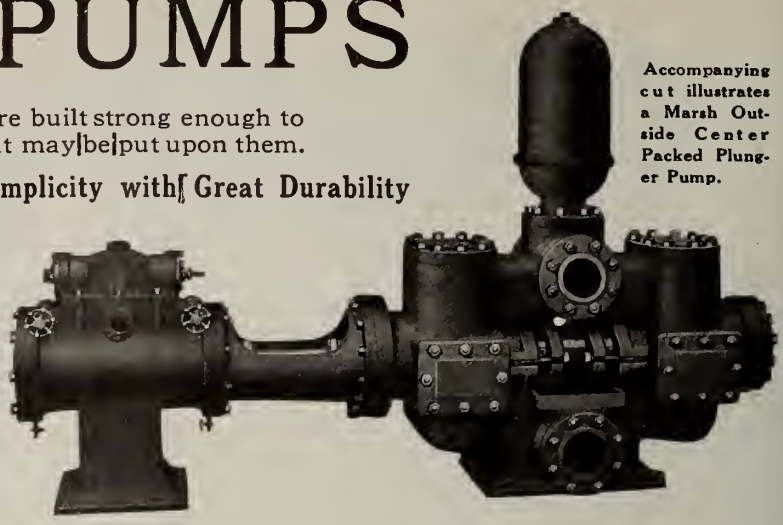
P.O. Box 1754
PITTSBURG, PA.
Works:
HOMESTEAD, PA.



MARSH PUMPS

Are the heavy, massive kind, that are built strong enough to withstand any unforeseen strain that may be put upon them.

They Combine Efficiency and Extreme Simplicity with Great Durability



Accompanying cut illustrates a Marsh Outside Center Packed Plunger Pump.

TAKE the pump shown here, for instance, note the massive construction, note the absence of outside moving parts on the steam end and the general simplicity in construction throughout. The Marsh Pumps are not cheap in any sense of the word. They are built for long, continuous service and every pump is absolutely guaranteed for the service on which it is recommended. We stand back of all our material and workmanship for one year.

Our new No. 18 general catalog illustrates and describes the different types of Marsh and American Pumps. Write to-day for your copy. It is a treatise and reference book every engineer and power plant superintendent should possess. It is free on request.

CANADIAN AGENTS

A R. Williams Machinery Co., Toronto
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Hallman & Peniston Machinery Co., Vancouver, B.C
Mechanics' Supply Co , Quebec, Que.
Gorman, Clancey & Grindley, Limited.
Edmonton and Calgary.

AMERICAN STEAM PUMP COMPANY

Battle Creek, Mich.

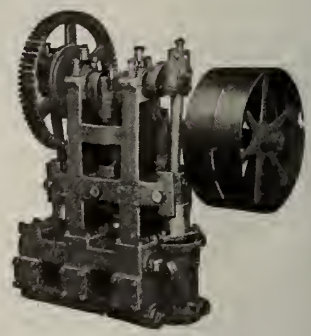
Deming Power Pumps

Made in Many Sizes

For all Pumping Conditions

Automatic Sprinkler System Pumps.
Boiler Feed Pumps.
Combination Water and Air Pumps.
Deep Well Working Heads.
Electric Driven Triplex Pumps.
Gas Engine Driven Pumps.
Paper Makers' Pumps.
Railway Water Supply Pumps.
Tank Pumps for light, medium or heavy service.
Waterworks Pumps.

and including many others. The entire line is shown in our catalogue "H."



Deming General Service Triplex Power Pump for operation by belt. Requires but little power for operation.

The Deming Company

SALEM - - - OHIO, U.S.A.

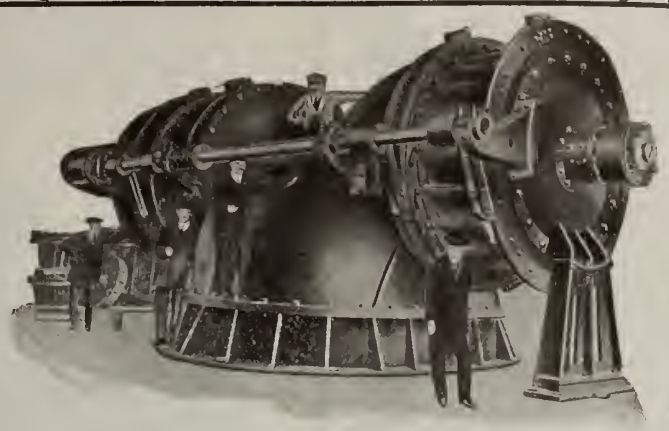
HAND AND POWER PUMPS OF ALL KINDS.

Agencies—Henion & Hubbell, Chicago, Ill.; Darling Bros., Montreal, P.Q., Can.; Morgan Engineering Co., Seattle, Wash.; Root, Neal Co., Buffalo, N.Y.

WATER TURBINES
—AND—
GOVERNORS

All Sizes

Maximum Efficiency



All Heads

Ideal Control

ASK FOR PARTICULARS FROM

THE CANADIAN BOVING CO., LTD.

164 BAY STREET, TORONTO.

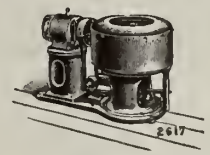
Branch Office for British Columbia, 427 Seymour St., Vancouver

BELT DRIVE

BELT DRIVE

ENGINE DRIVE

WATER DRIVE

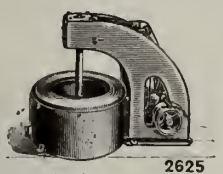

ELECTRIC DRIVE

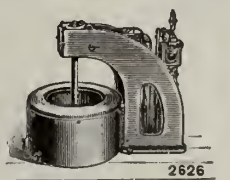
2629
ELECTRIC DRIVE

BELT DRIVE

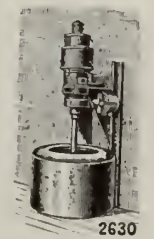
HYDRO-EXTRACTORS

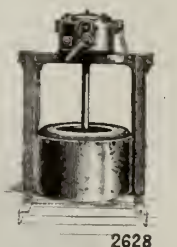
To Meet All Requirements


2625
BELT DRIVE


2626
ENGINE DRIVE

2627
ELECTRIC DRIVE


2630
ELECTRIC DRIVE


2628
WATER DRIVE

WATSON, LAIDLAW & CO., LTD.

98 DUNDAS STREET (South), GLASGOW

For further particulars, apply to:—

JONES and GLASSCO, St. Nicholas Building, Montreal.

The advertiser would like to know where you saw his advertisement—tell him.

Save Fuel and Increase Profit

A few engineers find this a difficult problem. They are not acquainted with

The "OTIS"

TUBULAR FEED WATER HEATER, OIL SEPARATOR AND PURIFIER

The exhaust steam when harnessed and passed through this Heater will heat the Feed Water to a boiling point before it enters the boiler. This effects an enormous yearly saving in fuel.

Write for descriptive catalog and prices.

The STEWART HEATER CO.

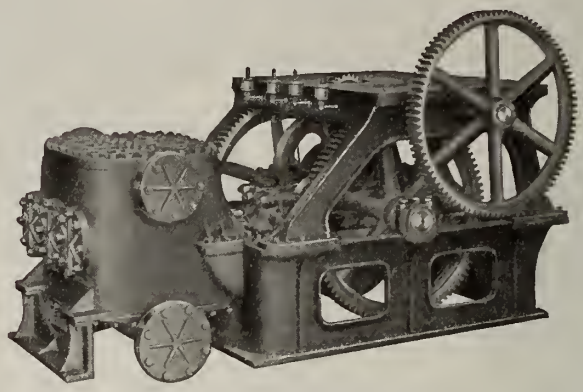
189 Norfork Ave., Buffalo, N.Y., U.S.A.

The Luitwieler Double Acting

Triplex Power Pump

Non-Pulsating **No Vibration**

Highest Efficiency



Send for Catalogue

The General Machinery Co., Limited

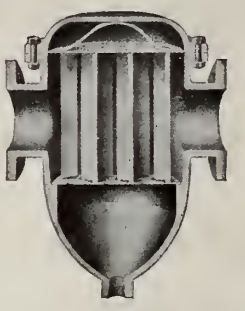
527 Traders Bank Building - Toronto, Ont.

Using Your Exhaust Means Fuel Economy

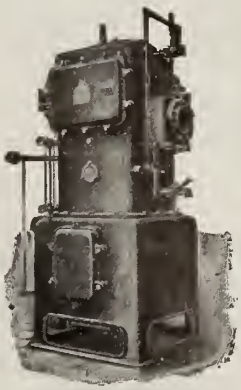
It means that there will be less heating for the coal to do, because the water will be well started on its way to steam by the heat of the exhaust.

Because the Webster Feed Water Heater utilizes the exhaust steam in the right way, it has become known to engineers as one of the prime savers in the plant.

Every Webster Feed Water Heater combines in its construction the highly efficient Webster Oil Separator, thus allowing the condensation to be used for boiler feeding. The water is heated by direct contact, so all the condensation is saved. The Webster Oil Separator makes exhaust steam fit for use in heating boiler feed water, in warming buildings and in various other heating and drying operations.



Webster Standard Horizontal Oil Separator.



Class "EC" Feed Water Heater and Purifier 50 to 300 h.p.

The Webster Heater was the first really successful open heater on the market and the only heater of the "vacuum" type. Upwards of 5000 Webster installations prove that unqualified success has followed them —why don't you investigate?

We'll Send Booklets Free.

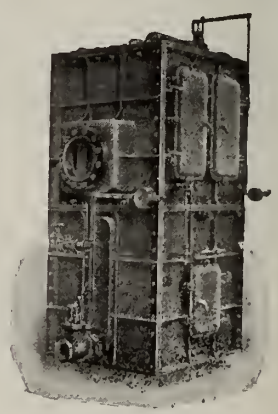
Darling Brothers, Limited

Head Office and Works:

15 Ottawa St., Montreal, Que.

St. John, N.B. Toronto, Ont. Winnipeg, Man.

F. DARLING & CO., Agents, Vancouver, B.C.



Class "EC" Type—1000 to 2,500 h.p.

The
Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars

Morehead Mfg. Co.
DEPT. "J." DETROIT, Mich.

Canadian Representatives—Geo. W. Cole, Woodstock, Ont.; H. E. Kirkham, Montreal, Que.; Park Bros., Chatham, Ont.; W. H. Rosevear & Son, Winnipeg, Man.; Robt. Hamilton, Vancouver, B. C.

NUMIDIAN CYLINDER OIL
VELOX ENGINE OIL
EVERY GALLON GUARANTEED

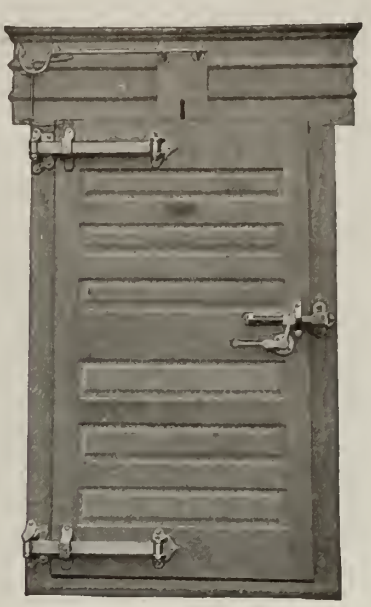
"The choice of every engineer who knows."

Before buying your next supply of oil, write us and let us send you a sample of these high-grade oils. They are certain to give you better power transmission and add longer life to your machinery.

Send us your request to-day.

C. C. Snowdon
Wholesale
P.O. Box 1384. CALGARY, ALTA.

J. V. Jamison, President. T. B. South, Vice-President. J. V. Jamison, Jr., Treasurer.



This "Ad" is addressed to users of

Refrigerator Doors, Windows and Ice Chutes
in Canada

for Cold Storage, Meat, Fish, Dairy, Poultry, Fruit and Vegetable products.

We guarantee our Doors not to sag or stick in the frames.

Our Hardware weighs 60 lbs. to set.

We manufacture or sell nothing else.

Our entire time and forces are directed to this line.

We supply

Linde British Refrigeration Co.
Linde Canadian Refrigeration Co. of Canada.
Armour & Co., Chicago, Ill., U.S.
Swift & Co., Chicago, Ill., U.S.

with all they use. Our latest orders are to Swift & Co., for Toronto, Can., 30 Doors; Canadian Fish and Cold Storage Co., Prince Rupert, B.C., 110 Doors.

Send for Catalogue

Jones Cold Store Door Co.
HAGERSTOWN, MARYLAND, U.S.A.

Detroit Lubricators for every purpose

TRADE MARK
REG. U.S. PAT. OFF.

Detroit Lubricators are made in styles and sizes for every kind of service.

Regardless of the conditions under which it must operate, there is a Detroit Lubricator that will eliminate every element of chance of uncertainty from the lubrication of the machine with which it is installed.

Every lubricator is carefully designed for the work it is to do and embodies in a compact and well balanced design all of the esentials of a perfect lubricating device.

Detroit Lubricators are characterized by all of the refinements and improvements made possible by long experience in the sale and manufacture of lubricating devices of every kind and by careful study of the varied conditions under which they are used on all kinds of engines, all over the world.

Engineering Service Department

The Detroit Lubricator Company maintains an engineering department that is at the service of users of lubricating devices. It is our aim to assist every owner of a Detroit Lubricator to get the greatest efficiency from it.

If he is not sure as to the exact style and size of lubricator his machine needs, if he is in doubt about the proper method of installation and operation—if he needs help of any kind, he can write us and our service department will be glad to to help him.

DETROIT LUBRICATOR COMPANY.

DETROIT, U.S.A.

Largest manufacturers of lubricating devices in the world.

GET FAMILIAR

with your lubrication problems.

Find out *why it is* that oil cannot be relied upon to reduce friction as well as a body grease, and just why

Albany Grease (All Lubricant No Waste)

is superior to all other lubricants made

It is more effective because it maintains a *better film* between moving parts.

It is more economical because it *feeds only as needed.* When the need stops, Albany does too.

It never fails at the critical time—it stays "put" in the parts—it is true lubricating economy.

We will send you free a liberal sample of Albany Grease, an Albany Grease Cup and our new and instructive book "Death to Friction."

Give it an impartial but *thorough* test.

AT YOUR DEALER—IF NOT, ORDER DIRECT.

Albany Lubricating Co.

Adam Cook's Sons, Proprietors.

708-710 Washington St. **New York**

The advertiser would like to know where you saw his advertisement—tell him.

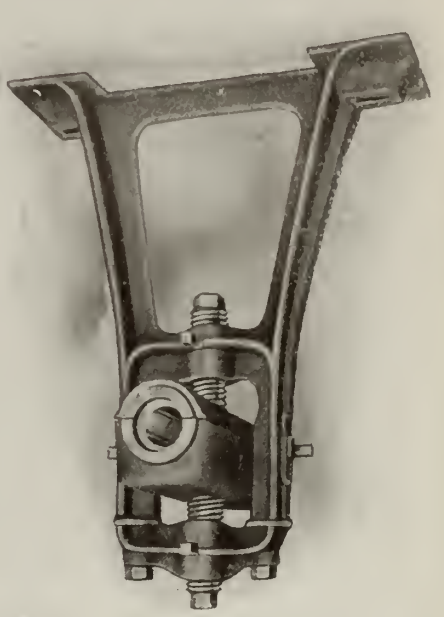
A Combination Hard to Beat

Elmira Ball and Socket Hangers

Elmira Wood Split Pulleys

The Elmira B. & S. Hangers are designed to meet the hardest and most exacting conditions. They are of good weight, correct design, and well proportioned. A Duplex system of oiling is employed consisting of tempered steel rings and woven cotton wick.

The Elmira Pulley is built to stand the hardest service and most severe conditions. The rim is nailed throughout. The arms are tenoned into the rim and dowelled there. The pulley is guaranteed to run wherever a leather belt will give satisfaction.



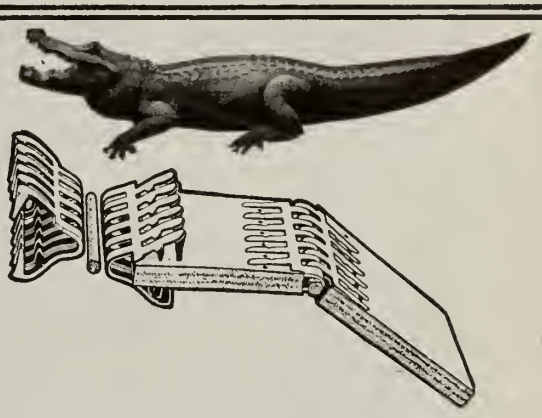
Send for our Illustrated Catalogue "C."

Large and complete stocks carried at Elmira, and by

The A. M. ELLICOTT CO., 301 St. James Street, Montreal, Que., Sole Eastern Agents.

Elmira Machinery & Transmission Co., Limited - - Elmira, Canada

A Preventive of Many Belting Troubles



This is a Belt Lacing that will prove of utmost value to you.

Requires no tool but a hammer to make the joint, and after it is applied forms th estrongest part of the Belt.

ALLIGATOR FLEXIBLE STEEL BELT LACING

The **Flexible Joint** ensures quick contact with the Pulley, whether the Belt is run with either or both sides in service, and as the lacing engages both sides of the Belt alike the strain is thrown directly in alignment with the pull. This makes a joint which is easy on the Belt.

No punch holes are required.

Joint can be made at a great saving of time.

Let us send one on trial. Put it to a test with any other Lacing. Then you will be convinced that it is a trouble saver.

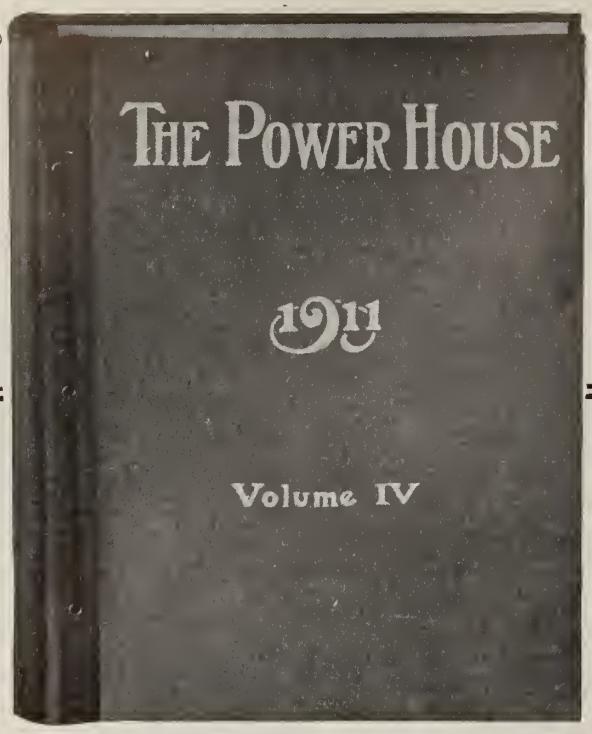
Write for particulars to-day.

The Crescent Oil Company

Hamilton and Toronto, Ontario

Stocks carried by—Sadler & Haworth, Montreal; Austen Bros., Halifax; P. A. Gouin, Three Rivers, P.Q.; J. S. Mitchell & Co., Sherbrooke, P.Q.; Great West Engine Packing Co., Winnipeg; F. H. Andrews & Son, Quebec, P.Q.; E. N. Jones, St. John, N.B.

The advertiser would like to know where you saw his advertisement—tell him.



More Valuable Than Most Books

is a complete file of

"THE POWER HOUSE"

The binder shown is designed to hold twelve numbers of "The Power House" and prevents the loss or soiling of the magazine.

The 12 numbers will make a handy book size and gives our readers the opportunity of preserving their copies and placing the bound volume in their library

A complete alphabetical index of articles published during 1911 is bound in the back of this issue and can be easily removed.

Price, Postpaid, 50 cents.

THE POWER HOUSE
143 UNIVERSITY AVENUE
TORONTO

An Opportunity FOR Subscribers

One New Subscription

sent us by a subscriber, with one dollar, paying for the first year from an Engineer not already a subscriber, entitles you to

THIS TAPE OR RULE

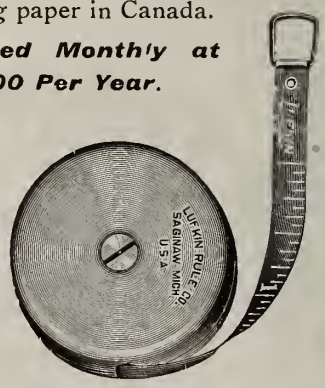
They are both made by first-class mechanics, and are articles that every Engineer should have.

DO NOT HESITATE in accepting this offer as **you** know the value of Power House and can easily secure a subscription on your own testimonial.

"The Power House" is a necessity for every engineer who wishes to keep posted on the latest ideas, and its advertising columns are a safe directory for all sorts of supplies.

Act at once—the Power House is the easiest sold engineering paper in Canada.

Published Monthly at $1.00 Per Year.



THE POWER HOUSE
143 UNIVERSITY AVE. - TORONTO

The advertiser would like to know where you saw his advertisement—tell him.

We have been appointed Agents for the

WESTON ELECTRICAL INSTRUMENT CO.

Weston electrical measuring instruments possess to a very marked degree those qualities of originality and excellence of mechanical and electrical design and construction that distinguish Weston products from all others and we claim for them a perfection with respect to accuracy, reliability, serviceability and durability that has hitherto been unapproached.

A new and complete line of Alternating Current Switchboard Indicating Instruments is offered, comprising Wattmeters (single and polyphase), Power Factor Meters, Synchroscopes, Frequency Meters, Voltmeters, Ammeters and new models of Weston D. C. Instruments to match.

In the design and manufacture of these instruments, each and every detail has received that careful study essential to insure a perfect performance of its functions, and therefore the purchaser is assured that from each instrument there will be received the highest degree of serviceability and durability, combined with accuracy of indications under the most trying conditions met with in practical work.

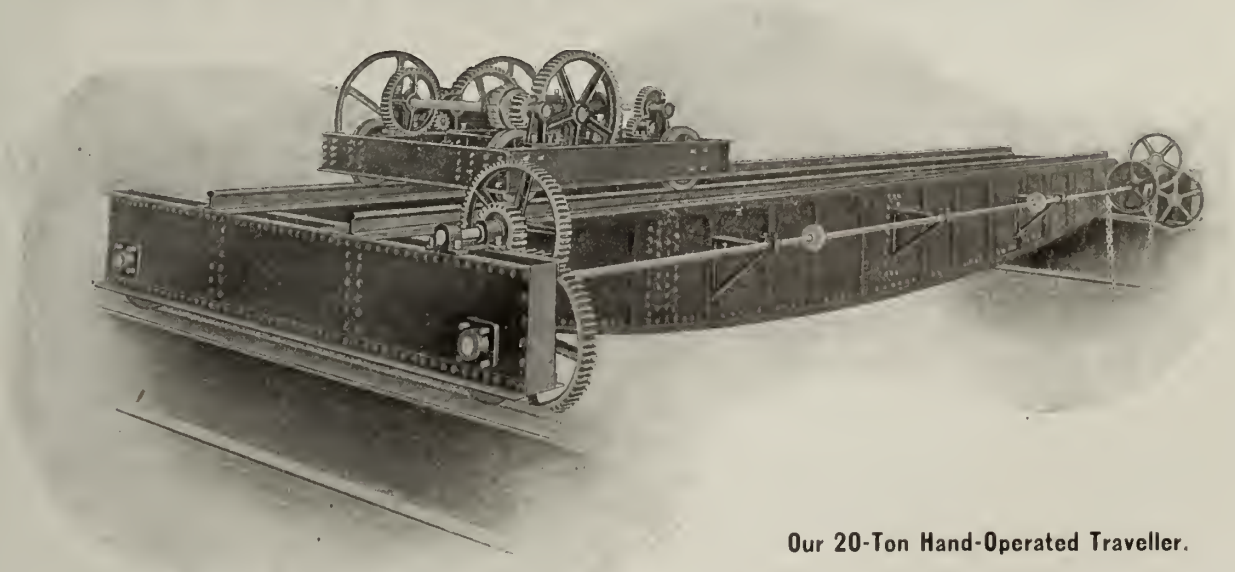
We will be pleased to send Catalogue No. 2072 on request.

THE Northern Electric AND MANUFACTURING CO. LIMITED

Manufacturer and Distributor of Telephone Apparatus, Electrical Supplies, and Fire Alarm Apparatus for every possible need.

Address our nearest house: Montreal Toronto Winnipeg Regina Calgary Vancouver

ALL TYPES **CRANES** ALL SIZES



Our 20-Ton Hand-Operated Traveller.

We design and manufacture all kinds of lifting and hauling appliances. Our experience and advice will be found worth having; let us know the nature of your business and we shall be pleased to advise the best equipment for your purpose.

International Marine Signal Co., Limited, Ottawa, Ont.

The advertiser would like to know where you saw his advertisement—tell him.

Would you like to Spend your Sundays at Home?

Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

YOU can reduce the labor and expense of boiler cleaning and cut down your consumption of fuel by using

McCOLL'S Special Boiler Compounds

or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

WRITE FOR PARTICULARS TO

McCOLL BROS. & COMPANY

Montreal, Toronto, Winnipeg or Vancouver

The Wheels of the World Turn Faster

Because of increased steaming efficiency due to

Dearborn Water Treatment

Steam plant operators in all parts of the world are getting increased steaming efficiency with decreased fuel cost, and eliminating shut-downs and costly boiler repairs, by having their boiler feed waters **DEARBORN TREATED**, to prevent scale formation, corrosion, pitting, and all troubles due to the action of mineral elements in the water.

When steam users in far-off Honolulu, Manila, Shanghai, and Tokio, realize the costly destructiveness of incrusting solids in the feed water sufficiently to send samples of water thousands of miles across land and sea for analysis by the Dearborn Laboratory, why should our neighbors in Canada deny themselves the advantage of the same service?

Dearborn Treatment is saving money for hundreds of industrial concerns in this and foreign countries. It will save money FOR YOU. Why not investigate now?

SEND GALLON JUG OF YOUR BOILER WATER FOR ANALYSIS.

Dearborn Drug & Chemical Works

General Offices, Laboratories and Works, Chicago

The advertiser would like to know where you saw his advertisement—tell him.

BOILER ENAMEL

is a guaranteed preventative of boiler scale, pitting, corrosion, priming, foaming, etc., which will work equally well in any class of feed water.

"ECLIPSE" is made entirely from tropical plants, and in the process of manufacture no chemicals of any kind are added. It is chemicals that prove disastrous to many boilers and their fittings.

Being harmless, it is slow in its action on old scale, but is deadly sure.

The cost of using "ECLIPSE" in your boilers cannot be compared with the great saving that results from its use.

PROFIT BY THE EXPERIENCE OF OTHERS by writing us for testimonials from many well-known firms in Canada who use this boiler enamel. Their verdict will convince you that "ECLIPSE" will save money.

We guarantee satisfaction, or money refunded.

It's a paying proposition. Write us at once.

W. W. CARRUTHERS

388 Edmonton Street, WINNIPEG, Man.

AGENTS:

J. A. Cartwright, 616 Wellington Street, London, Ont.
A. J. Chamberlain, 52 Colborne Street, Toronto, Ont.
J. H. Elliott, 42 Fort Street, Montreal
W. L. Magee, Middleton, N.S.

The Murphy Automatic Smokeless Furnace

Commercially on the market 30 years. It is not an experiment.

See advertisement in the Power House, page 14, April, 1912.

Repeat Orders Are the Best Evidence of Merit.

In March, 1905, we contracted with the Laurentine Paper Co., Grand Mere, P.Q., for Murphy Furnace Equipment for nine 250 H.P. water-tube units. It was arranged that three units should first be shipped and, if our guarantees were sustained by tests, then the other six units to be shipped quickly. The first three units were installed, test demonstrations showed economy in coal alone at the rate of more than $20,000 per year; the six remaining units contracted for were shipped.

In July, 1907, they gave us **A SECOND ORDER** for Murphy Furnace Equipment for **TWO 400 H.P. WATER-TUBE UNITS**; and **APRIL, 1912,** they gave us **SECOND REPEAT ORDER** for Murphy Furnace equipment for **TWO LIKE SIZE BOILER UNITS**—same as covered in 1907 contract.

If you desire catalog, test data, etc., write:—

MURPHY IRON WORKS, DETROIT, MICH. BUFFALO, N. Y.

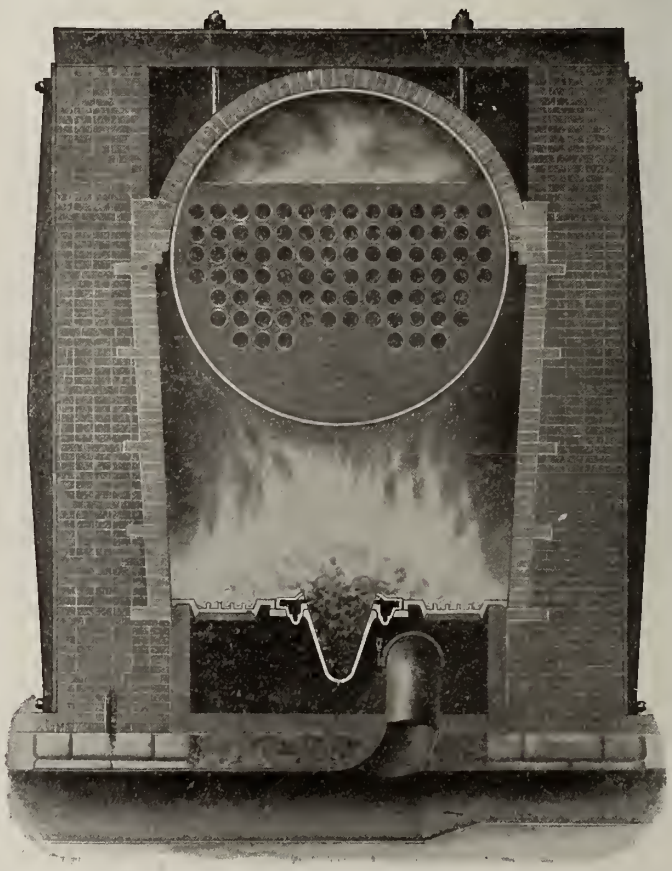
NO LOSSES

THERE are no grate bars in a Jones stoker, consequently NO LOSS of fuel through the bars.

The gases are driven off the coals and mixed with air ***beneath*** the fuel bed, pass through the fire, are brought up to the ignition temperature and consumed, consequently NO LOSS in unburned gases! NO SMOKE!

Utilizing the fuel with a minimum of loss, and with the automatic regulation of the steam pressure by the steam pressure itself, make a Jones Underfeed Stoker installation an ideal system of firing a steam boiler plant.

Let us tell you more about it.



Jones Underfeed Stoker Co., Limited

National Trust Bu lding TORONTO

Coristine Building MONTREAL

RE-ORDERS

are Proof of the

Efficiency

of the

20th CENTURY GRATE BAR

That is not all. It is sold under our iron-clad guarantee to save fron 10% to 25% on fuel costs.

The heat resisting qualities cannot be excelled. It is impossible for the gate to warp or burn out.

The 20th Century Grate Bar

welcomes comparative tests. Its construction allows a larger air space than that which can be procured on any other grate. Also has a greater dumping capacity for removal of clinkers.

Investigate the 20th Century—it is the greatest money saving proposition on the market and we want to prove it.

Write for full details.

The Boiler Repair and Grate Bar Company

Room 217 St. James' Chambers, 69 Adelaide Street East, Toronto

BENNIS CHAIN GRATE STOKER

More air space is provided to each square foot of grate area than with other makes, and without additional widening of the **actual** air spaces.

The continuous surface of the grate ensures economy in the length of the grate.

By means of the continuous drive, smoothness of running is assured.

The speed of the stoker can be adjusted to a nicety, as there are six variations.

The stoker can be easily hand-fired in case of emergency.

Fine slack fuels can be satisfactorily burnt.

Write for "Boiler House Economy," Pamphlets and Full Particular to

GEO. H. TOD 213 Manning Chambers Queen Street West **TORONTO**

THAT DEVICE

WILL
INCREASE HORSEPOWER
AND
SAVE FUEL

Do you need more power? Do you want to cut down fuel bills? If so you had better investigate

"The Typhoon" Turbine Blower

Find out what it is doing for others by writing us for testimonials. Then you will **be convinced** that this Blower is a necessity to your Boiler Room.

This System of Mechanical Draft permits the use of the cheapest grades of fuel, yet in many cases produces better results than the natural draft. You will secure complete combustion and increased boiler rating.

Can be automatically controlled so that it will stop and start with a rise and fall of temperature.

WRITE TO-DAY.

The Hare Engineering Co., Limited

14-16 King Street East, TORONTO

Interior View
Casing Removed

Figure the Saving!

Figure out for yourself how much you could **save**, in **coal**, if you were using the

Vulcan Soot Cleaner

Figure it on the following basis:

Cost of Coal

Average coal consumption by average water tube boiler per day..... 10 Tons
Three hundred working days per year..... 3,000 "
Cost of Coal at $3.00 per ton.....$9.000.00

Estimated Saving

By keeping the tubes absolutely clean with the Vulcan you save at least..... 5 per cent.
5% on $9,000 ..... $450.00

Cost of Vulcan

Average cost of Vulcan Soot Cleaner per water tube boiler..... $275.00

Returns on Investment

Average returns on the first cost of Vulcan, per year..... over 150 per cent.

Actual Saving

Evaporative tests with the VULCAN frequently show an increase in evaporation of 8 to 10 per cent.

The Vulcan for Fire Tube Boilers costs only $55. Guaranteed to pay for itself in six months.

In fact, the Vulcan Soot Cleaner produces more economy per dollar invested than any steam appliance connected with power plant practice. **That's why over 50 per cent. of the Vulcan business to-day is repeat orders.**

You know *your* plant—just figure what an annual five per cent. saving on *your* coal bill would amount to—then remember that the Vulcan is a guaranteed proposition—you risk nothing. Can you afford *not* to investigate? The facts are here—our booklet "Economical Steam Production" tells the whole story and gives much valuable data about soot and its removal.

A copy is yours for the coupon. Mail it now.

Vulcan Tube Cleaning Systems, Limited

Factory and Home Office:

4-11 Bonsecours St., -:- MONTREAL.

SIGN, TEAR OUT AND MAIL

Power House, Feb. 12, *Date*.....

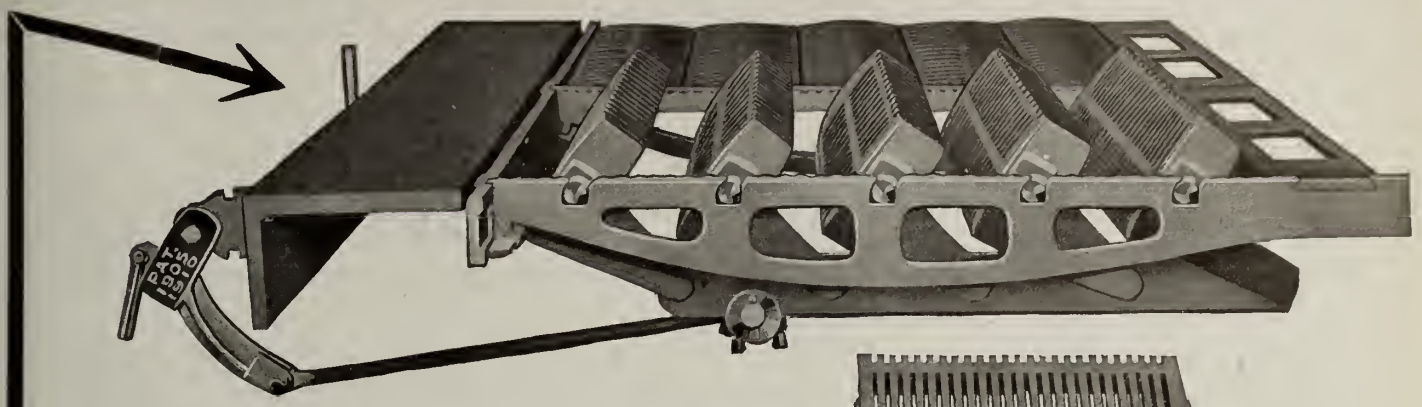
Vulcan Tube Cleaning Systems, Limited,
4-11 Bonsecours St., Montreal.

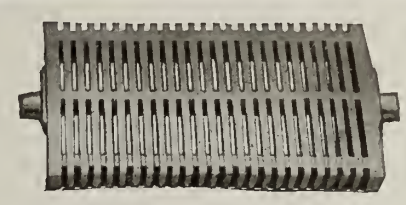
Please send us, without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.
(It is important that following information be given in full.)

Water Tube Boilers. Number.....Type.....Pressure.....
Horsepower.....No. Tubes High (except on Stirling boiler).....
Any Superheaters.....Width of alley space at side.....
Tubular Boilers. Number.....Horizontal or vertical.....
Name.....
Address.....

"THE Cyclone"

Shaking and Dumping Grate Bar





"The Grate Bar that is Imitated But Not Equalled"

This is the Grate Bar that has a record of long economical service. It is the "imitated kind" and only the best grade is mitated. However, the "Cyclone" leads them all in quality—it always wins out in the endurance test. Produces the same result from burning cheapest grades of fuel as that obtained by burning the best.

READ THAT LETTER

It is only one of the many testimonials that are constantly coming to hand.

Read it, because it is the evidence of the user. Why not profit by his experience and permit economy in your boiler room?

Write us for full details and prices.

Toronto, November 21st, 1911

Messrs. Canadian Steam Boiler Equipment Co., Ltd.
186 Queen Street East
City.

Gentlemen:—

In reply to your enquiry of the 21st, re the Cyclone Shaking and Dumping Grate Bar, we may say that we think we were the first people to use shaking and dumping grate bars on a brick kiln, viz., those you supplied us with four years ago. I have examined this grate bar and find that they are just as good as the day they were installed.

The last kiln you equipped with the improved Cyclone Grate Bar is giving excellent satisfaction and I think that the best testimonial that I can give is the fact that a few days ago I gave an order for another set of grates for my boiler, as I consider the installation of these grates will very soon pay for itself. They are saving probably 25% of my fuel bill.

Yours very truly,

(Signed) ISAAC PRICE.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST - - - - TORONTO, CANADA

AGENTS

ST. JOHN, N. B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.

Every Up-to-Date Plant Should Investigate

The "Stanlock" System

of

Heating and Ventilating

This system consists of units as shown below. They are made of steel tubes screwed into circular cast iron bases and through these tubes steam passes. Enclosing these tubes is a sheet metal cylindrical casting with a motor at the top. The air is forced downwards, thus keeping the floor warm. A special pipe can be fitted, passing through the roof or through the side wall, thus giving a supply of fresh air. Dampers are provided so that the inside air can be circulated or outside air can be taken in and heated.

Advantages of the "Stanlock" Multiple Unit System

1. No overhead air ducts are required.
2. No underground masonry ducts are required.
3. No obstruction to light due to overhead air ducts.
4. No heat losses due to radiation from air ducts.
5. Minimum of power absorbed.
6. Units hung on walls. No floor space needed.
7. Various units operated independently and can be turned on or off like radiators. Some supply fresh heated air and others merely circulate and heat.
8. A unit using 60 lb. steam pressure heats 3,600 sq. ft. of floor space.
9. The first cost of apparatus is very low.
10. Units may be added at any time in case of extensions, and in case of boiler shops, units may be removed entirely during the summer months, if desirable.

The Garth Company

Selling Agents for the Dominion of Canada

26-32 Craig Street West - MONTREAL

Do You Know to a Pound How Much Coal Your Boilers Burn?

Don't You Want to Know?

FAIRBANKS' SUSPENSION COAL SCALE
Montreal Tramways & Power Co., Limited

Not knowing, to the pound, how much coal your boilers burn, how can you determine with any degree of accuracy the efficiency of your boilers? The true energy-producing quality of your coal? The cost of your power?

We show here a one ton Fairbanks' Suspension Coal Scale, with quick weighing dial, installed in the Power House of the Montreal Tramways & Power Co., Limited. With this scale they can check to a pound the amount of coal the boilers use.

The scale hopper is mounted on a trolley which runs on a track in front of the boilers and this trolley is operated by means of a motor controlled from the floor below. The scale hopper is filled from the overhead coal bunkers, the coal weighed, and the trolley is then run along the track until it is opposite the boiler you desire to feed. There the coal is dumped into the feed hoppers of the automatic stokers.

This scale should be in every up-to-date power house. It can be adapted to meet your requirements. Let us know what the conditions are in your power house. Write for further particulars.

The Canadian Fairbanks-Morse Co., Limited

FAIRBANKS' SCALES—FAIRBANKS' VALVES—FAIRBANKS-MORSE GAS ENGINES, SAFES, VAULTS, Etc.

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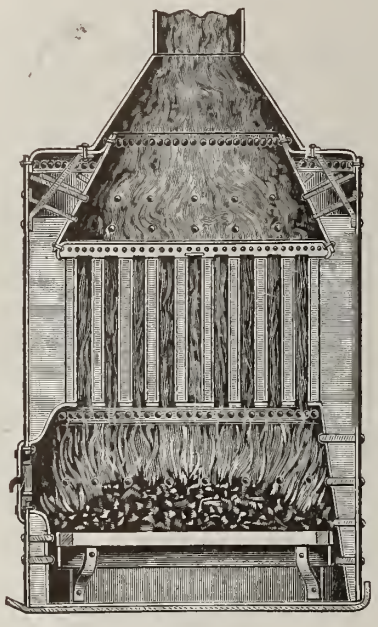

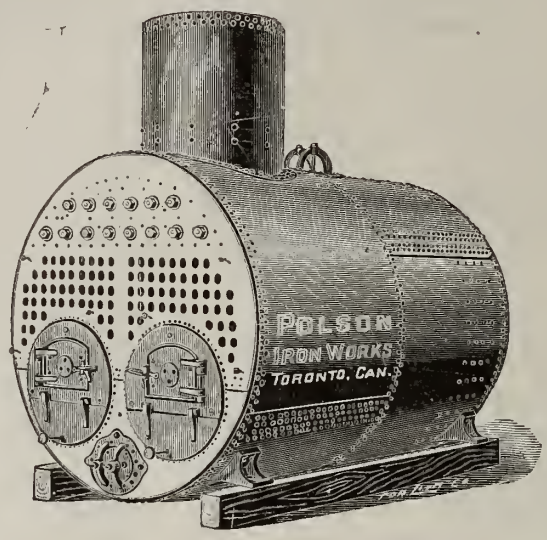

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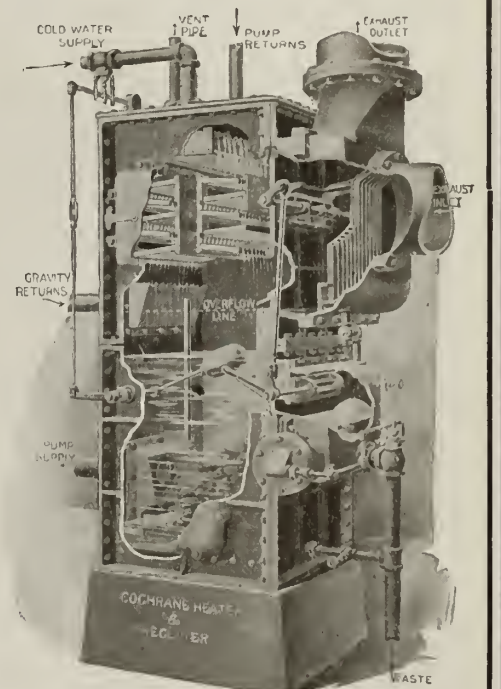

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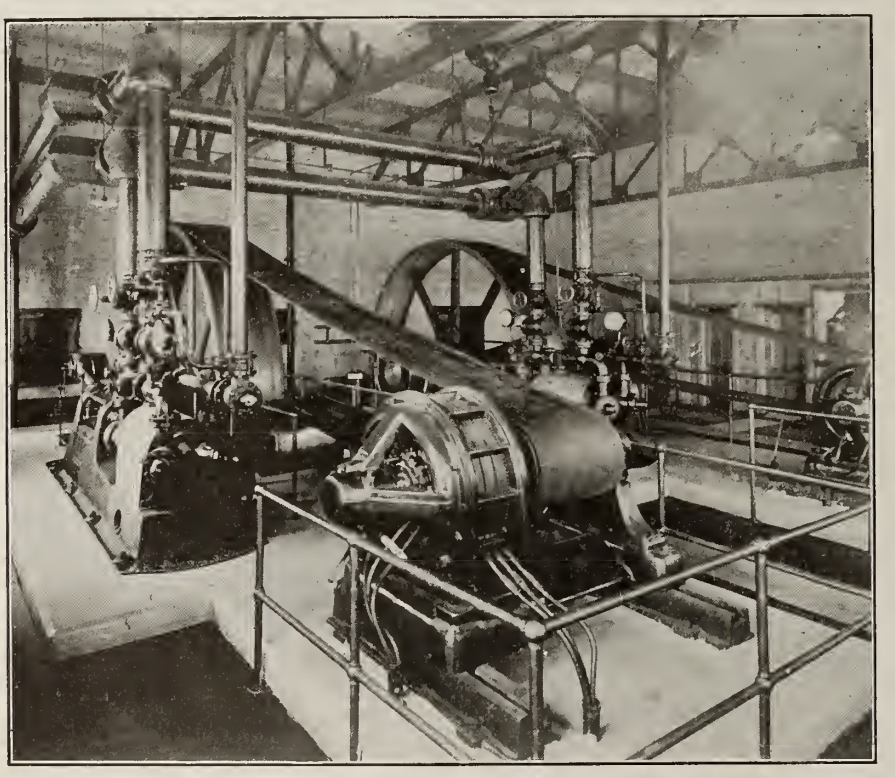

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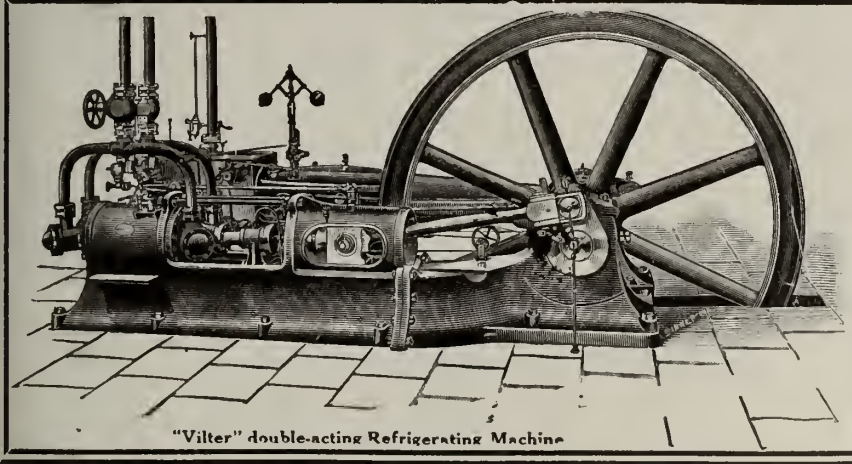

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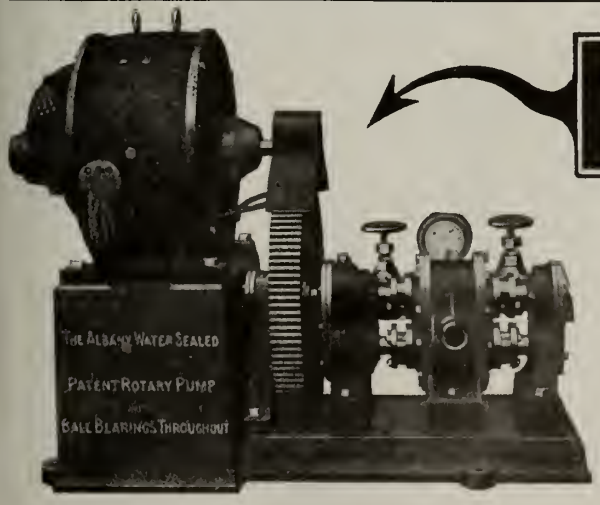

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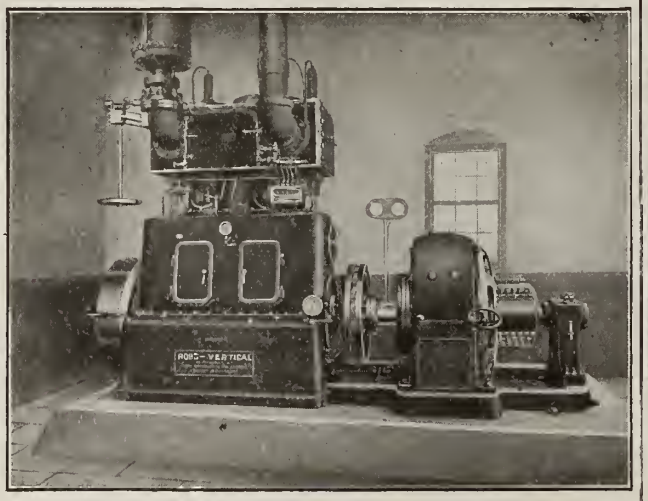

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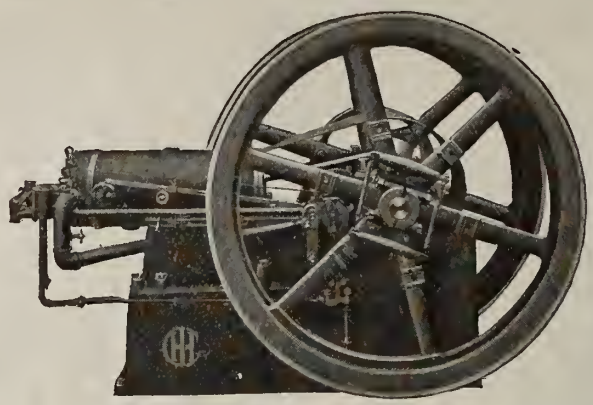

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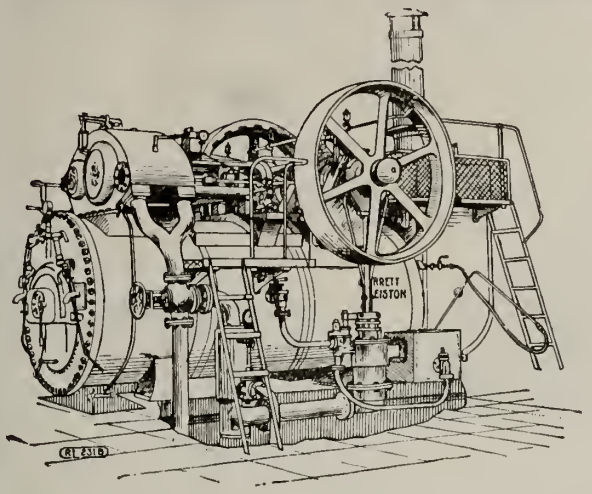

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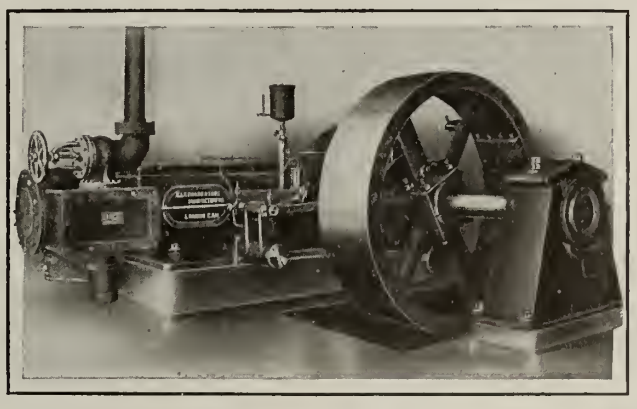

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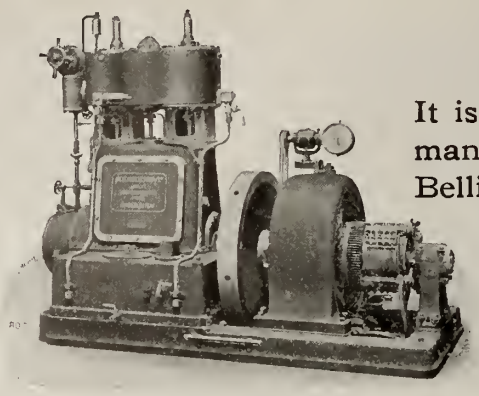

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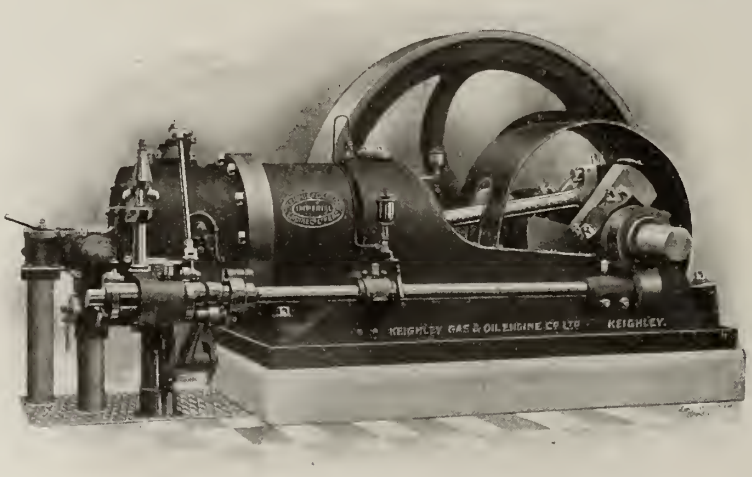

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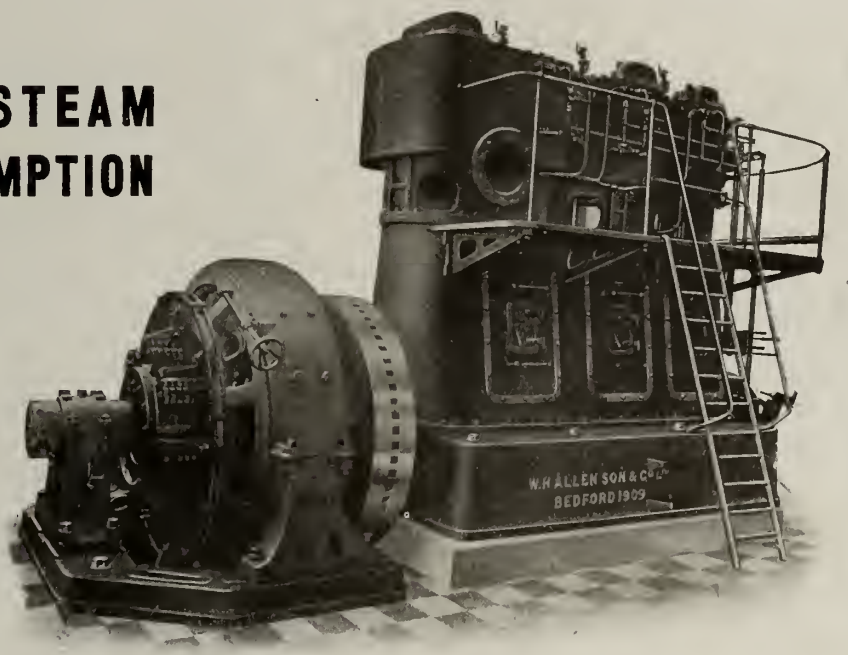

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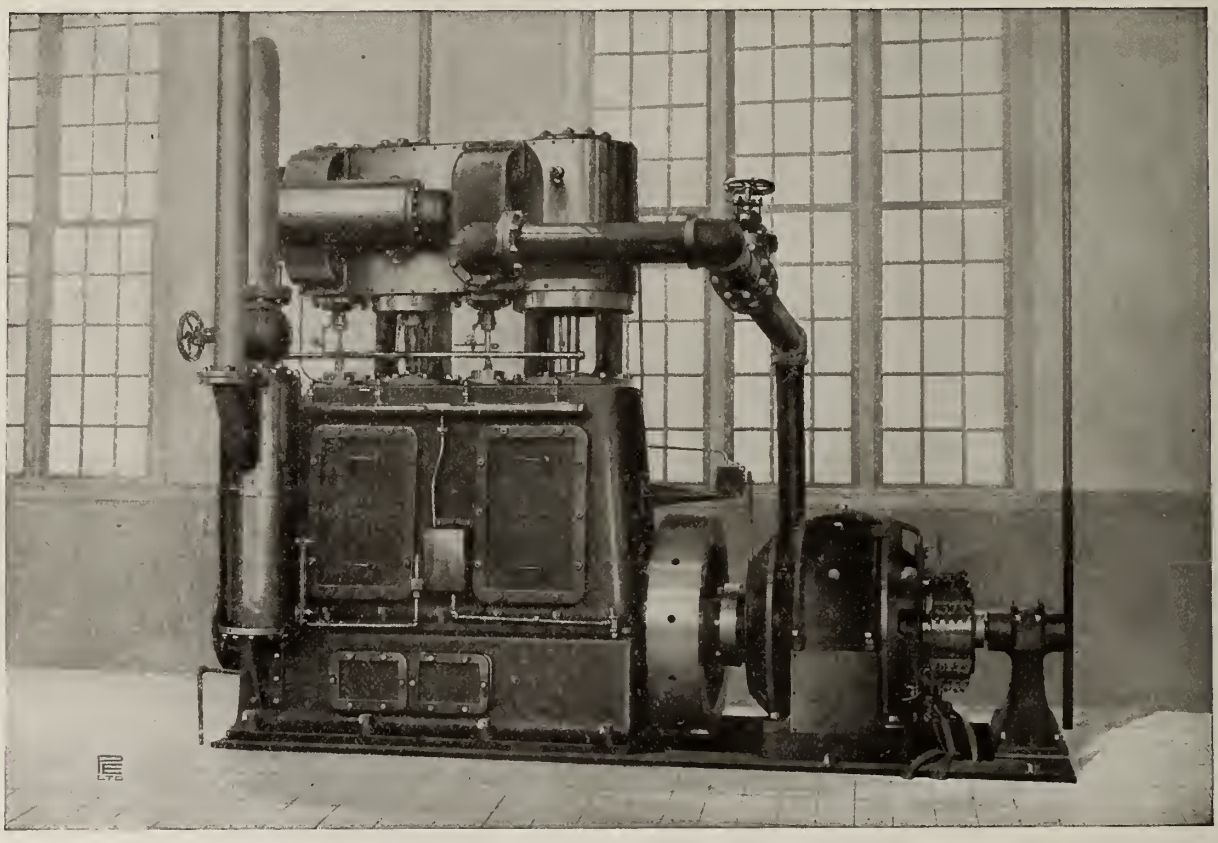

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The Present State of Development of Large Steam Turbines*

By A. G. Christie, Madison, Wis.

The author of this paper goes very fully into the steam turbine question, and while indicating the outstanding features of the different designs with which are associated the names of the personages from whose brain they have emanated, shows that the most successful products in this field at the present time are those which combine the good points of two or more types, and have deleted the objectionable features previously existing in each individually.

STEAM turbines are being used for driving alternating-current generators, turbo-compressors, turbo-blowers, pumps and marine propellers; and, by means of gearing, to furnish power to direct-current generators, rolling mills and the propeller shafts of steamships. Reciprocating engines were formerly used for such purposes, but recently this class of engine has seldom been installed except for rolling-mill work, non-condensing service as on heating systems, rope and belt drives, hoists, and in certain combinations with low-pressure turbines in marine work. The high economy of piston-pumping engines and also of some types of air compressors, has continued their popularity in spite of the increasing competition of steam turbine units. The steam turbine has found favor principally on account of its low first cost of installation, its small floor space requirements, its continued good steam economy over a period of years and its small operating and repair charges. The increased use of steam turbines in sizes up to 1,000 h.p. seems, however, to have received at least a temporary check in Europe by the introduction of the new Stumpf direct-flow engine.

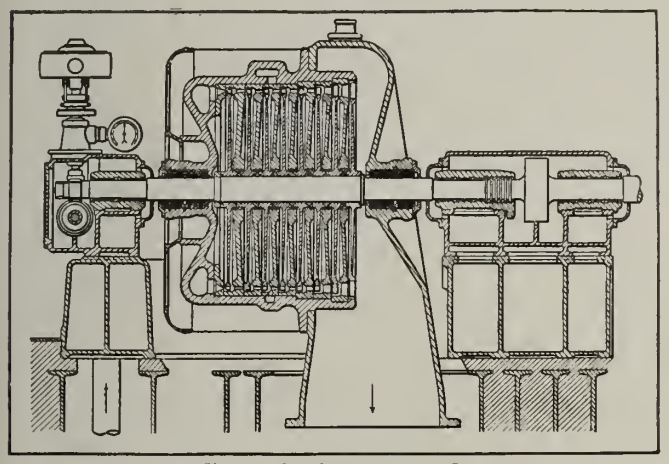


Fig. 1 — Section of Zoelly Turbine.

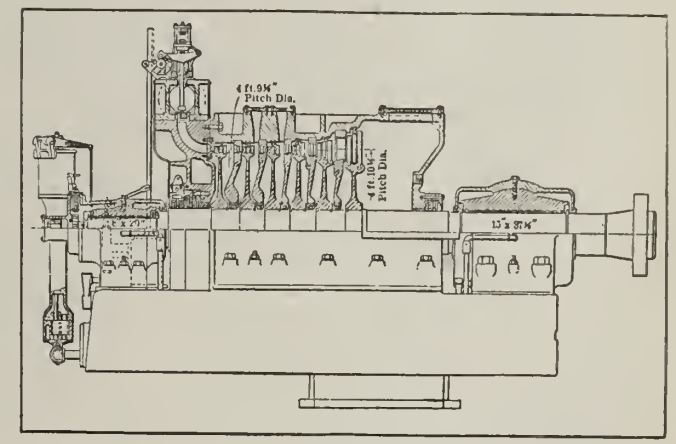


Fig. 3 — Six Stage Horizontal Curtis Steam Turbine.

Types of Steam Turbines.

For the purpose of this paper, large commercial steam turbines will be divided into two classes:—(a) fundamental types, and (b) modified or combined types. The fundamental types of turbines are as follows:—

1. **The Parsons type,** which works on the so-called "reaction" principle. In this type, the heat energy of the steam is changed into kinetic energy, both in the stationary guide blades and in the moving blades. In other words, both sets of blades act as orifices expanding the steam through a small pressure drop. As nozzles and orifices usually have very high efficiencies, this turbine should, theoretically, prove the most economical of all types. The construction of the Parsons turbine is familiar to all engineers. It consists of a drum, or a number of drums, carrying the blade rows which alternate with rows in the casing. The drums carry balance pistons to equalize the end thrust.

2.—**The Curtis type,** which works on the impulse principle with high steam velocities and few stages. Each stage, however, is provided with two or more rows of revolving blades known as "velocity rows," with intermediate rows of guide blades. The steam velocity at the beginning of each stage is high. The revolving blades are carried on disks separated by diaphragms, which extend to the shaft and which carry the orifices between stages. Curtis turbines are now usually built with horizontal shafts. In American practice some sizes over 7,000 kw. still have vertical shafts.

3.—**The Rateau turbine,** which consists of a number of simple impulse wheels in series on the same shaft and separated from one another by diaphragms carrying nozzles. It operates with lower steam velocities than the Curtis and consequently has many more stages. Each revolving element carries only one row of blades.

The type of turbine known as the **Zoelly** belongs to the same classification as the Rateau, from which it differs only in the use of higher steam velocities, in the number of stages and in certain constructional details. Fig. 1 shows a section of a Zoelly turbine. Though this type has been widely adopted abroad, it has not been placed on the American market up to the present time.

Each of these fundamental types is based on sound theoretical principles. In the process of manufacture and in operation, certain features have not proved entirely satisfactory, hence far-reaching modifications have been made in the design of some types of turbines. Some manufacturers have combined the characteristics of two or more types to overcome the inherent limitations of each fundamental type. A discussion of the unsatisfactory operating conditions of each type will show the reasons which led up to the changes in recent turbines and will also aid in distinguishing the novel features of new designs.

The Parsons Turbine.

The first rows of spindle blades in a standard Parsons turbine are placed on a drum of small diameter in order to

*Paper read at the spring meeting of the American Society of Mechanical Engineers.

make the blades as long as possible and to minimize the proportional leakage losses past the ends of the blades. A large number of rows are provided in order to keep the steam velocities low, as the blade velocities must be low with the small drum. The drop in pressure at each row is small and hence the leakage is correspondingly reduced. This construction results in a turbine with a long spindle and with great distance between bearings. High-pressure steam, frequently at high temperature, is admitted to the casing. Distortion of casing and spindle is thus easily conceivable in such construction, and to allow for this contingency the clearance on the ends of all blades is usually increased. This distortion may be due either to unequal heating or to the growth of the cast-iron casings. The fluid friction losses are large in this high-pressure section, for a large number of rows of blades must be revolved in steam of high density. The leakage losses and fluid friction in the high-pressure section, together with the troubles due to distortion in the long shaft, have forced designers to introduce modifications in this portion of the turbine, either by new blading arrangements, by dividing the total expansion in large sizes between two cylinders or by the introduction of impulse blading.

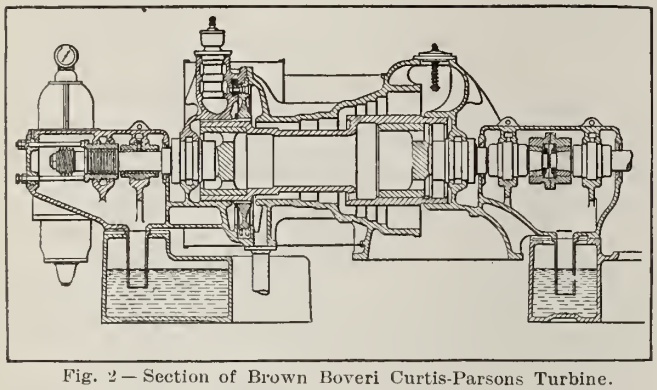


Fig. 2 — Section of Brown Boveri Curtis-Parsons Turbine.

The low-pressure sections of Parsons turbines have always shown high efficiencies. As low steam velocities are characteristic of this type, there is no cutting away of blade material, even with very wet steam, provided no injurious properties are present in the feedwater. This low-pressure section has, therefore, been altered only in details. The presence of a large low-pressure balance piston in close proximity to the steam inlet has frequently been the cause of serious distortions. Many builders now place this balance piston in the exhaust end, a construction due to Fullager.

The Curtis Turbine.

The Curtis Turbine utilizes high steam velocities in all stages. As steam becomes wet through expansion in the low-pressure stages, there is frequently considerable cutting of the blade material by the steam, although, contrary to first expectations, there is seldom cutting in the high-pressure blades due to the high initial velocities. The first row of velocity blades in a stage usually does the greater portion of the work, and hence the second row does not work at maximum efficiency. As the steam of the first stage is expanded very fully in the nozzles, there is no high pressure or superheat in the turbine casing or at the glands. The vertical type of unit is sometimes subject to electrical unbalancing and to other troubles peculiar to this construction. It is not as accessible in operation as the horizontal machines. Recent designs have provided for horizontal units and for the replacement of the low-pressure section by sections of other types.

The Rateau Turbine.

The Rateau turbine has high pressures on the gland at one end. There are a large number of disks revolving in dense steam at high-pressure end. It has lower steam velocities throughout than the Curtis, and consequently has no blade-cutting effects in the low-pressure section. The clearances around the blades are large, but the shaft clearances of the diaphragms must be kept small. Some builders of this and the Curtis type have brought out new designs which employ the high-pressure section of the Curtis with the low-pressure section of the Rateau. These represent a compromise between efficiency and manufacturing costs.

Modified or Combined Types.

Under the classification of modified or combined types, there are turbines with modified Parsons, Curtis and Rateau construction, and turbines with combinations of Curtis-Parsons, Rateau-Parsons, Curtis-Rateau and Curtis-Zoelly construction, with a few special combinations. Some typical turbines of these classes are described in the following paragraphs.

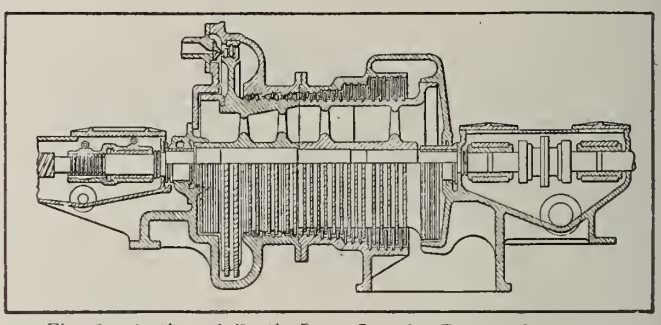


Fig. 6 — Section of Curtis Drum-Impulse Parsons Turbine.

Allis-Chalmers Co. Turbine.

The Allis-Chalmers Co. manufacture a turbine of the modified Parsons type. High peripheral speeds are employed with a decreased number of rows. A portion of the theoretical efficiency in the high-pressure end has been sacrificed by the use of fewer blade rows. Also, a smaller proportion of work is done in this section than is usual in Parsons turbines. The blades are all provided with

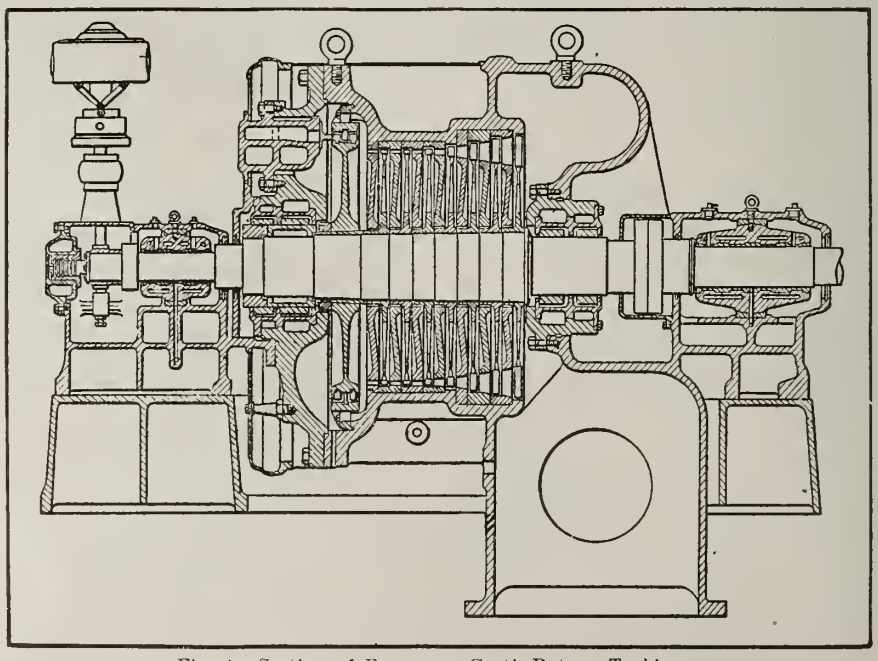


Fig. 4 — Section of Bergmann Curtis-Rateau Turbine.

a channel-shaped shroud. European experimenters have pointed out that better efficiencies are obtained with shrouded than with plain blades, as the so-called spilling-over at the ends is prevented. Wing blades are fitted in the last low-pressure rows to take care of the large volumes of low-pressure steam. The spindle is much shorter and stiffer than the standard Parsons, and hence smaller clearances can be provided. The Fullager low-pressure balance piston is also used. The outstanding features of this design are, reaction principle with drum construction, few rows of blades with high steam velocities, short spindle construction, and employment of wing blades for high vacuum. The steam consumptions obtained on this type show improved efficiency over standard construction.

Other Modified Parsons Types.

A number of Parsons turbines have been built in which the total expansion is divided between two cylinders. One of the best known units of this type is installed at Dunstan Power Station, England. This was built by Richardsons Westgarth & Co. to Brown-Boveri designs. This unit, however, employs a modified double-flow Parsons construction in the low-pressure cylinder.

C. A. Parsons & Co. have used cast-steel cylinders for the high-pressure portion of their turbines so as to overcome the troubles due to deformation and growth of metal under high pressure and superheat experienced with cast-iron casings.

Westinghouse Machine Co. Turbine.

The Westinghouse Machine Co. have develops a double-flow turbine which employs a Curtis high-pressure stage with Parsons intermediate and double-flow low-pressure sections. There is only one balance piston in this turbine next to the Curtis ring. These turbines run at high speeds, have short shafts and small clearances. The steam is expanded in the nozzles, and hence there are no high pressures or temperatures in the casing. By providing two low-pressure sections, high vacuum can be economically utilized.

Combination Curtis and Parsons Types.

European builders of Parsons turbines, among whom are Brown Boveri & Co., C. A. Parsons & Co., Franco Tosi, Sulzers, Willans & Robinson and Erste Brunner, have replaced the high-pressure sections of their Parsons turbines by a Curtis wheel with two or more velocity rows, but have retained the single-flow Parsons drum construction for the remaining portions. One of these units is shown in Fig. 2. The temperatures and pressures in the casing are low as the steam is expanded in the nozzles. The distance between bearings is decreased, the shaft is stiffer and clearances are smaller than in the standard Parsons turbine. The Fullager balance piston is used in the turbines of several of these builders. Turbines built in this manner have shown some exceptionally good efficiencies. Compared with the Westinghouse turbine, the leakage at the end of the low-pressure blading is less than in the double-flow section. On the other hand, the Westinghouse machine has smaller balance piston losses and can also utilize the highest vacuum at better efficiency.

Melms & Pfenniger employ a drum impulse section of about five stages instead of a Curtis ring on some of their large turbines. They claim improved efficiency from this construction, though high-pressure and high-temperature steam are introduced into the casing.

Horizontal Curtis Type.

The General Electric Co. now manufacture a horizontal type Curtis turbine in all sizes up to 7,000 kw., a section of which is shown in Fig. 3. This embodies all the essential features of the Curtis design. Compared with the vertical type, this design provides easier access to all working parts such as governor, bearings, valves, etc., and allows a better survey of the unit. The machine can also be dismantled and its internal parts examined with less trouble. The oiling problem is very simple compared with the vertical units, as there is no step bearing to provide for. It is possible that only horizontal units of all sizes will be built in the near future. The A. E. G. also builds similar turbines up to 1,000 kw. capacity.

Curtis and Rateau or Zoelly Type.

Many manufacturers in Europe are now building a turbine of the type shown in Fig. 4. This consists of a Curtis high-pressure with Rateau or Zoelly low-pressure sections, the number of stages depending on the size of the machine, the speed and the steam conditions. The pressure and temperature in the casing are low, as a consequence of the expansion of the steam in the nozzles. The steam velocity is moderate in the low-pressure section. This machine is longer than the simple Curtis, but shorter than the Rateau. Its builders claim improved efficiencies over either of the fundamental types.

Belliss & Morcom, of Birmingham, England, have introduced a turbine, which consists of a high-pressure Curtis stage with a low-pressure drum construction like Parsons, but fitted with impulse blading on the spindle and blades forming expansion parallel wall nozzles in the casing. All other impulse turbines employ diaphragms extending to the shaft. There are a greater number of rows in a Belliss turbine than in a corresponding Rateau turbine, and hence a lesser pressure drop through each set of guide blades. The net leakage loss may thus be lower than the Rateau, even though the leakage area is greater. This turbine is essentially a Curtis-Parsons construction, with few rows of blades and with the expansion taking place in the stationary blades only.

A turbine, shown in Fig. 6, has recently been patented in England, which has some features of unusual interest. The high-pressure stage is Curtis, the intermediate section is of a drum impulse type with three stages, while the low-pressure portion is Parsons, which may be also double-flow. This combines features of all three fundamental types, and it will be interesting to see what results are obtained in practice by such an arrangement.

A continuation of this paper will appear in our June and July issues.

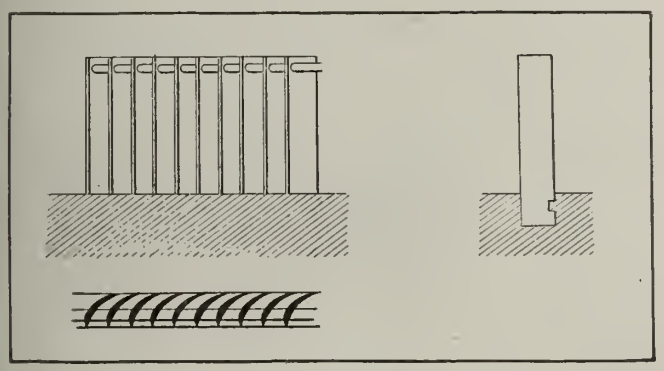


Fig. 5 — Brown-Boveri Reaction Blading.

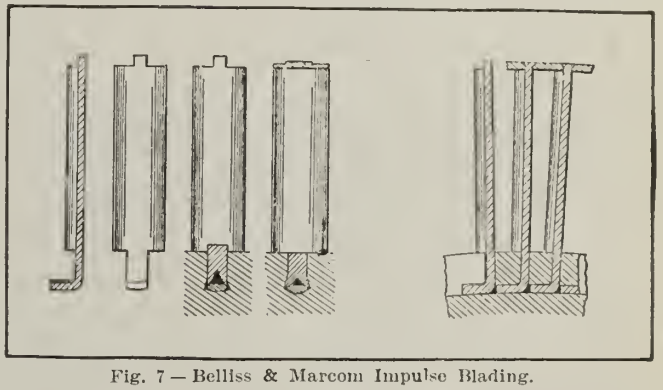


Fig. 7 — Belliss & Marcom Impulse Blading.

The Locomobile: A Consideration in Power Plant Practice

By H. A. Wilson

Being an outline description of a combination power generation unit which has much to commend it, and concerning the large measure of achievement in development and progress which has been effected and with which many of our readers are to a great extent not conversant.

THE internal combustion engine is rapidly displacing steam units of small capacity in many industrial concerns. The reason for this is because of the small space these power generators occupy. The steam engine, however, is still considered the more reliable of the two prime movers by many users of power. To meet the raipdly increasing competition on its own ground, the well known firm of Richard Garrett & Sons, Ltd., Leiston, England, are putting on the market, steam units which are models of economy, compact design, and durability. They are manufacturing several types, namely the portable, which is permanently mounted on wheels; the semi-portable, from which the wheels can be quickly removed and rigid frames inserted, and the semi-stationary, which is very similarly constructed to the others. These latter, although not provided with wheels, form, nevertheless, a compact and rigid unit, which can be easily moved with the aid of rollers and jacks. To economize space and add to the compactness of the apparatus, and thereby make the units more easily handled, the engines of all types are mounted on the rigid shell of the boiler. With a view to increased economy, the semi-stationary engines are built compound, either condensing or non-condensing. The single cylinder engine is designed to run non-condensing only. All types are provided with superheaters, and, as a consequence, the engines operate with superheated steam. In the following paragraphs, the details of these engines are treated, and it is hoped that the reader will be able to understand how with good design and careful manufacture steam-power generators can be built whose economy and whose durability will cause users of power to give more than a casual glance at the equipment.

General Design and Construction.

The feature that attracts most attention at first sight is, of course, the fact that the engine is mounted on the boiler shell. This reduces the room required for boiler and engine by fifty per cent. at least. It also eliminates the expense of "bricking in" a boiler; the latter being, instead, well lagged with some non-conductor of heat. Again, the steam pressure is not reduced by having to pass through long lines of piping to the engine. As the pipes from the boiler to the cylinder are extremely short, condensation does not exist; besides, the saturated steam is passed through a superheater located in the upper portion of the smoke box and a great deal of the heat of the flue gases

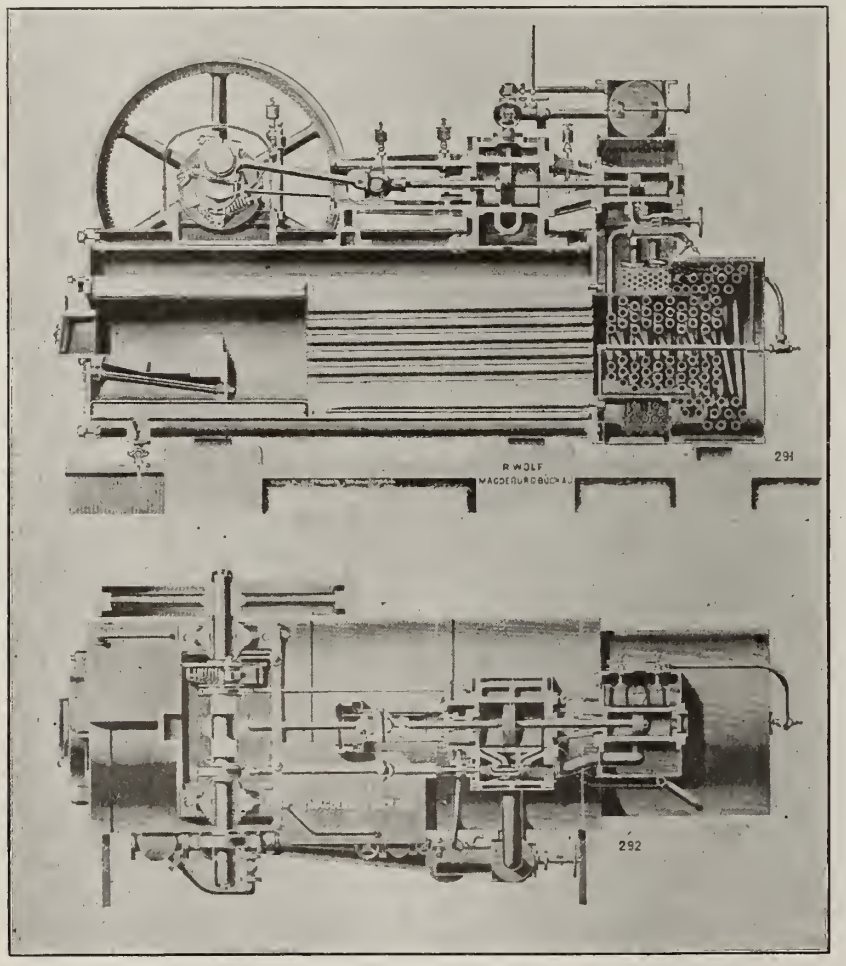
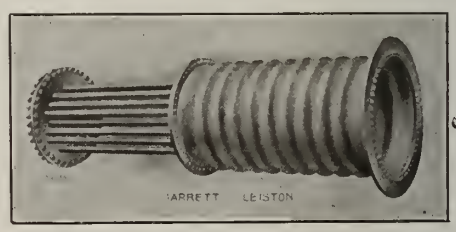


Diagram showing Construction of Parts, and Paths of Steam and Hot Gases.



Circular Corrugated Firebox and Tubes.

is absorbed in the superheating process.

The efficiency of the boiler compares very favorably with most other standard types, and as various kinds of fuel can be burned under the boiler, several designs of firebox have been provided. Among the fuels that can be taken care of by standard types of fireboxes are coal, petroleum, naphtha, sawdust, saw mill refuse, brown coal dust, lignite, cotton sticks, rice and coffee husks, tannery refuse, peat, etc.

Engine Particulars.

The cylinders, of close grained cast iron, are provided with steam jackets. Both these and the piston valve casings are bushed so that when these latter are worn they can be replaced. The bolts which fasten the cylinders to the flanged steel saddle on the top of the boiler are machined, and therefore hold the former rigidly in position. The piston rods and piston valve rods are fitted with stuffing boxes of suitable design

for packing material, specially adapted for the higher temperature of superheated steam. Furthermore, the cylinders are lagged with approved non-conducting material, and covered with sheet metal casings. The system of lubrication is of the latest and most satisfactory type.

The cylinders are surmounted by domes, wherein are placed the double safety valves, the distribution of steam being effected by balanced piston valves, having four rings on each. This form of construction makes for tightness, and practically eliminates all leakage. Being balanced, little power is required to operate the valves, and the absence of vibration is a noticeable feature. The valves are of the inside admission type.

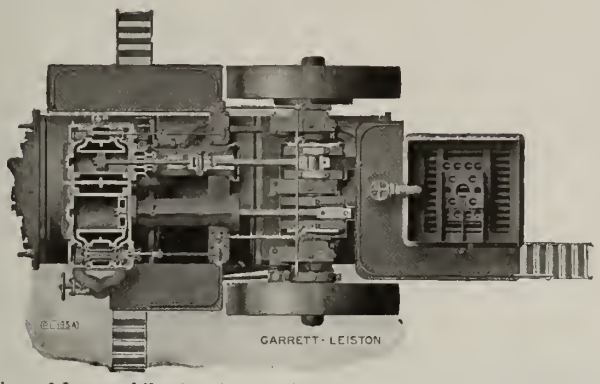
The governor is mounted on the crank shaft and controls, through the eccentric, the actual admission and cut-off of steam in the cylinder. This governor gives extremely close regulation; its degree of sensitiveness being about 2 per cent. The engine is designed so that it can be run either "under" or "over" by merely adjusting the eccentric on the crank shaft.

The crosshead guide is cast integral with the front cylinder cover, and is bored and faced at one setting, thus assuring perfect alignment. The crosshead is of cast steel, and fitted with slippers of special cast iron, which are adjustable.

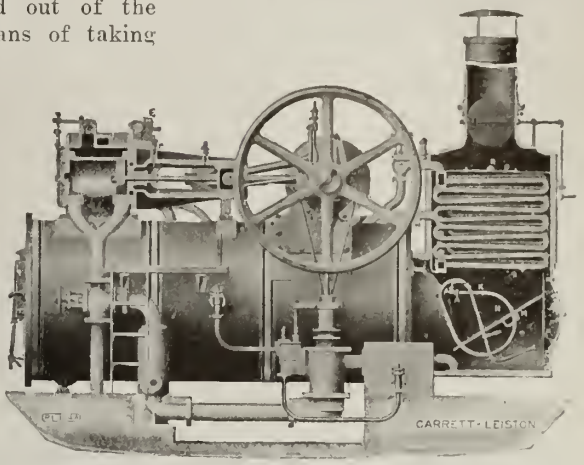
Each connecting rod is forged from a hammered ingot of best quality steel; being afterwards machined and polished. The recesses for the brasses at the small ends are machined out of the solid and convenient means of taking up wear are provided. The big end connecting rod brasses are lined with anti-friction metal.

The crank shafts are machined from solid steel forgings and are of such dimensions that all possibility of springing and bending is avoided. The cranks are also balanced. The crank shaft bearings are rigidly fixed with machined bolts to a steel saddle, which is securely riveted to the boiler shell. The bearing consists of two halves, between which an endless chain is placed, hanging over the shaft and dipping down into an oil chamber at the bottom. When running, the shaft causes the chain to revolve, and this continually brings up on the shaft from the well fresh oil, which is fed into both halves of the bearing. A plug showing proper level of oil, a filling plug in the bearing cap, and drain cock form part of the construction of each bearing. There are two bearings in the single cylinder type.

All reciprocating parts are fitted, while the boiler is under steam, thus doing away with undue strains on these parts when the engine is running. The cylinder, crosshead guides and crank shaft bearings are all mounted on heavy steel saddles, securely riveted to an extra heavy boiler shell. This has been found to constitute a very rigid foundation.



Plan of Locomobile showing section through H.P. and L.P. cylinders.



Side elevation of Locomobile showing section through Cylinder and Superheater Chamber.

Boiler Feed Pump and Heater.

The feed pump is driven from an eccentric on the crank shaft, and is of the plunger type. It is situated on the side of the boiler and takes water from the source provided, delivers it to the feed water heater and thence to the boiler. Hand pumps and injectors do not form part of the regular equipment, but may be supplied if required. The feedwater heater is of the tubular type; the water being heated by the exhaust

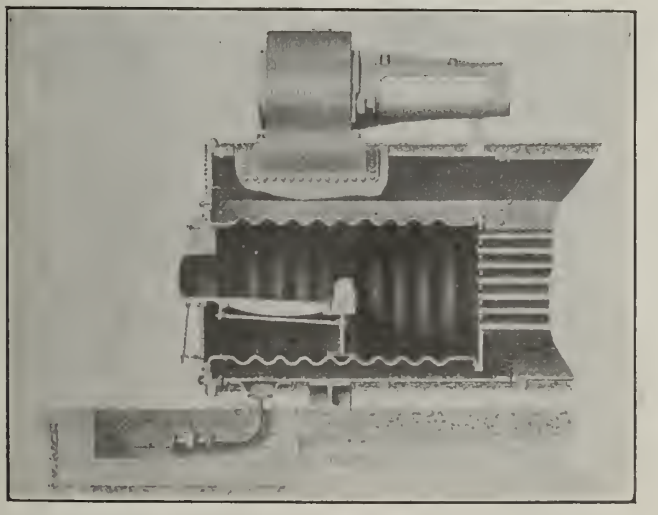


Illustration of Standard Grate.

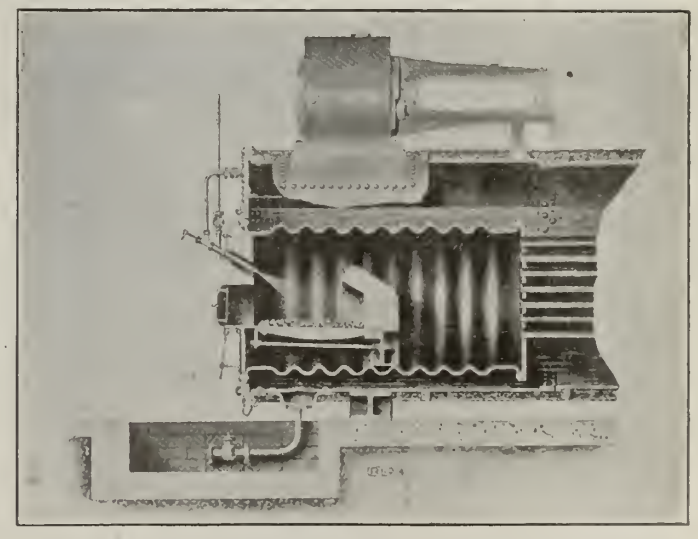


Illustration of Special Apparatus for Oil Fuel Burning.

steam passing through on its way to the stack. The shell is of cast iron fitted with two steel tube plates, into which are expanded a number of solid brass tubes. The temperature at which the water leaves the heater is between 150 and 165 degs. F. The exhaust steam does not come into contact with the feed water and thus no fatty or acid impurities reach the boiler.

Oil cups are liberally distributed around the engine, while the valves and cylinders are amply provided for by means of a positive feed oil pump.

Boiler Details.

The boilers are designed with an unusually large factor of safety, and especial attention is paid to the details. They are equipped with exceptionally strong and rigid shells, which take the place of foundation frames for the engines. They are designed to meet the requirements of all inspections for a working pressure of 170 pounds. The edges of all the plates are either turned, milled or planed, all holes are drilled, and after riveting the joints are caulked on both sides. The riveting is done by hydraulic pressure. The longitudinal seams are double riveted, as is also the circumferential seam joining the firebox shell to the boiler body.

The number of tubes varies according to the sizes of the units. The steam and water spaces are unusually large, when we consider the type of boiler. Riveted steel saddles with machined faces are attached to the boiler shell, to receive the pump check valve, steam jacket inlet and the saturated steam outlet from boiler to superheater. The firebox is of a more or less unique design. As the builders claim that in loco-type boilers more than one-half of the evaporation takes place around the firebox roof, in order to increase the area of the latter it has been made corrugated. One manhole of ample dimensions, with door, is fitted on the boiler barrel in a convenient position, so as to give ready access to the top of the firebox, which, on account of the absence of roof stays, is readily examined and cleaned. Mudholes are provided at all four bottom corners of the firebox, making the water spaces on all sides easy to clean out. Further mudholes are provided at the top corners of the front plate level with the firebox crown, and also at the bottom of the smoke box tube plate.

The Superheater.

The superheater is located in the smoke box; the saturated steam passing to a cast steel header. The coils entering the header are staggered in both top and bottom headers. This causes the flue gases to be thoroughly broken up among the coils without the use of baffle plates.

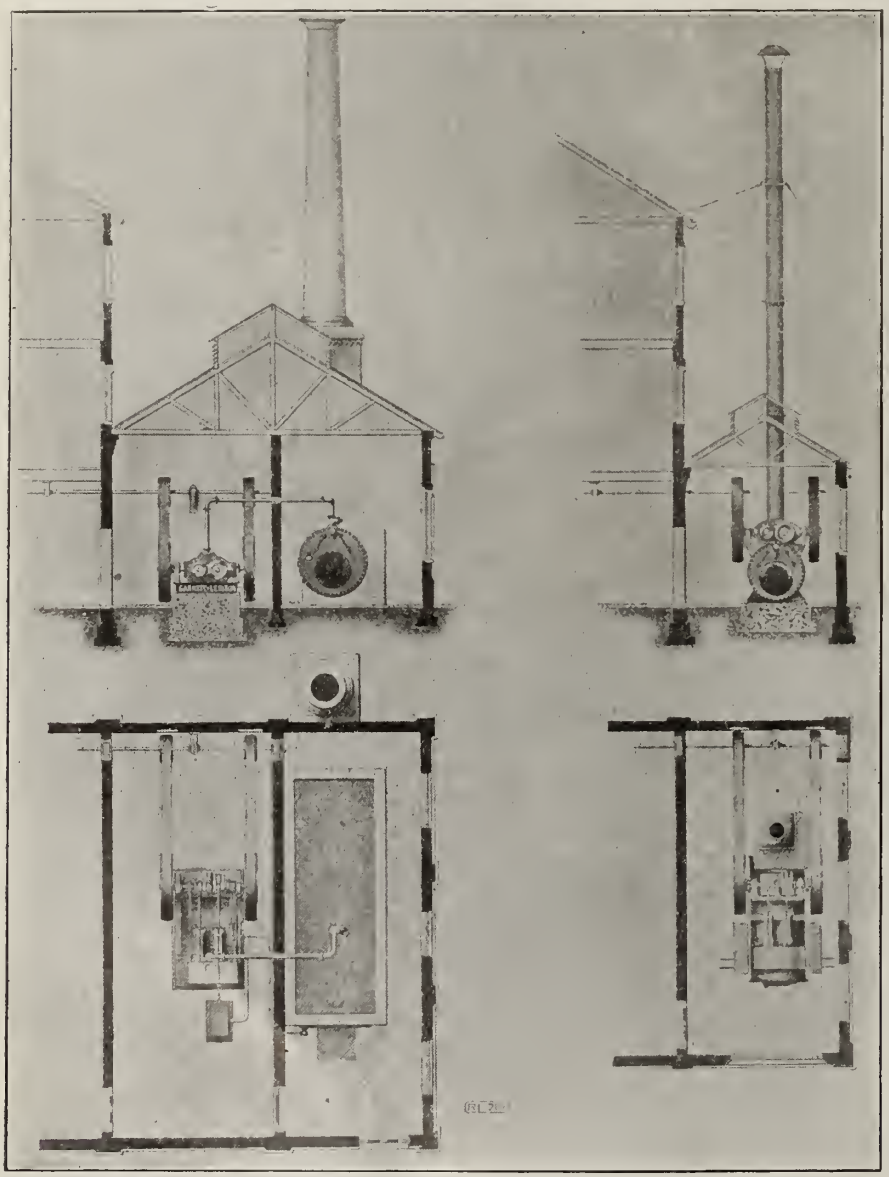
The saturated steam enters the upper header and passes into the coils at the top, where the flue gases are coolest. In passing through the coils it comes into contact with hotter gases, reaching the bottom header in a highly superheated condition; in which state it is admitted to the cylinders. The superheater coils are of small diameter, solid drawn seamless steel, so as to increase the efficiency. The countercurrent principle—i.e., steam circulating in a direction opposite to that of the flue gas, enables the greatest amount of heat to be abstracted from the latter. The superheater coils act also as an efficient spark arrester.

The boilers and superheaters are all tested to a pressure of 340 pounds per square inch cold water pressure. The engines have to undergo a prolonged brake trial at normal working steam pressure and speed, carrying the full test load. Indicator and speed diagrams are taken, as well as an accurate account kept of the fuel and water consumption during this trial. The whole of the boiler barrel as well as the smokebox and superheater chamber and the greater part of the external firebox shell are covered with a double layer of insulating material completely enclosed with wood lagging and a stout sheet steel casing. The latter is held in position by polished brass bands.

The remarkable economy of these engines will be seen by referring to the following set of figures which are taken from an official test of a stock engine:—

Test Particulars, Single Cylinder Unit.

Working steam pressure ..... 170 pds. per sq. in.
Cut off .....32 per cent.
Revolutions per minute 200
Mean temperature of feed water ..... 146 deg. F.
Mean temperature of steam .510 deg. F.
Load carried 26.3 brake or effective h.p.



Elevation and plan of a stationary steam engine and separate boiler.

Elevation and plan of a compound, superheated steam semi-stationary engine.

Mechanical efficiency .....89.7 per cent.
Water evaporated per lb. of coal.10.1 lbs
Water consumption per brake H.P. per hour .....22.62 lbs.
Consumption of coal (calorific value about 132.47 B.T.U. per lb.) per brake H.P. per hour .....2.23 lbs.

These figures show with what economy such an engine can be operated. The single cylinder type is never equipped with a condenser, and in many cases the exhaust steam is used for heating purposes. A large range of accessories is carried in stock or manufactured by the concern, thus a purchaser can have a plant which is as complete with regard to details as any large stationary unit could be.

Compound Semi-Stationary Unit.

The compound semi-stationary engine is fitted with piston valves on both high and low pressure cylinders; the governor being similar to that on the single cylinder engine, and operating on the H.P. cylinder only. The cranks are also balanced and are at 90 degrees to one another. The standard design requires this type to run "over," which feature can not be altered. However, if it is desired to run the engine "under," it can be made to do so by changing the eccentrics during construction. There are three bearings to support the crank shaft, all similar in design to those placed on the single cylinder engine, and two flywheels are fitted. The engine is equipped with a barring gear, so that a man can turn it into a ready position for starting.

The feedwater heater is similar to the single cylinder type, but somewhat larger. The compound engine is also equipped to operate condensing. The jet condensing apparatus is rather simple, and calls for no remark, but where the surface condenser is fitted an oil separator is furnished.

Boiler Features.

The boiler shells of all types are cylindrical; a unique feature being the removable tubes and the large water spaces. The circular joints are made at both ends by means of bolts and packing rings of special material. At the firebox end, the joint is made between the round firebox end plate (which is riveted to the flanged-out end of the circular firebox-firehole end) and either a specially rolled weldless angle ring riveted over the end of the shell for the smaller sizes, or a plain shell endplate riveted to this angle ring for the larger sizes. At the smokebox end the joint is made between the smokebox tubeplate and the plain shell end plate riveted to specially rolled weldless angle rings. These, in turn, are riveted over the end of the shell. By the simple and convenient process of unbolting and breaking these joints, the circular firebox, with the entire tube system and tubeplate, can be withdrawn whole at regular intervals, as may be necessary for periodical internal cleaning and removal of the injurious scale and deposits from the outsides of the tubes and from the outside of the circular firebox, as well as from the inside of the boiler shell. This, as can be readily understood, is a great convenience.

Forerunner of the Locomobile

Compound Unit Test.

The following figures are taken from an official test of a stock compound condensing engine, and will, no doubt, be interesting:—

Duration of trial .....7 hours
Mean R.P.M. 201.5
Mean temperature of feed water .....112 deg. F.
Mean temperature of steam 536.5 deg. F.
Average I.H.P. 58.25
Average B.H.P. 55.6
Mechanical efficiency 95.5%
Water evaporated per lb. of coal ..... 8.91 lbs.
Coal per B.H.P. per hour.....1.19 lbs.
Water B.H.P. per hour .....10.66 lbs.
Calorific value of coal used .....14260 B.T.U. per lb.

These remarkable figures show the excellent design of the unit, and when one considers the conditions under which the boiler and engine are constructed, the unique and compact design, and other attractive features, the fact must be admitted that those who contemplate using power in small units will do well to investigate this machine.

General Comparisons.

Comparing with gas engines, the following points must be noted and well weighed by the prospective customer before he will be able to intelligently decide which particular type is best suited to his requirements. Speaking generally, the initial cost of a gas engine is somewhat higher than that of a steam unit. The gas engine, however, only uses fuel while actually in operation. The cost of piping from a producer plant or from a "bricked in" boiler is saved when using the locomobile type of engine. The semi-portable and semi-stationary units are easily erected on their foundations, the one foundation answering for both boiler and engine. Compared with a suction producer or a separate boiler, the semi-stationary and semi-portable locomobile takes up much less floor space. Its compactness of design insures better attention to the various pieces of apparatus around the unit.

The depreciation in a steam plant is somewhat less than in a gas plant; however, when running, the gas engine requires less attention than the steam engine, and it also does away with that often tedious delay of raising steam. These units have a greater capacity for overload than the gas engine, being able to take care of a temporary overload of 50 per cent.

The Canadian agents for Richard Garrett & Sons, Ltd., are the Canadian P. J. Mitchell & Co., Ltd., Montreal, Que., to whom the writer is indebted for the cuts accompanying this article.

EFFECTIVE STRESS IN BELTS.

IN a recent issue of Zeits, des Vereines Deutscher Ingenieure appears an account of tests on the limits of effective stress in belts of various materials. An abstract of the article appears in the April Journal of the American Society of Mechanical Engineers. Such tests require a large expenditure of time, because overloading of a belt can be discovered only from the appearance of a permanent elongation, and an identical elongation is also found in a new belt which has not yet reached its state of resistance. Since, however, several hours are required for a belt to reach that state, there is always a danger, in short tests with new belts, of taking phenomena of the state of resistance for those of overload.

Tests of Link Belts.

The tests were made on two link belts of equal width, but unequal thickness, made up of links pressed out of specially prepared fibre, and provided with leather rims. The tests show that at a speed of say 50 feet per second, the total stress on the tight side of the belt must not exceed 166 lbs. per inch, but at higher speeds may go as high as 193 lbs. per inch of width of belt. Link belts have been introduced because they combined the strength of double with the flexibility of single belts, and gave strong belts which could be used on pulleys of small diameter. These tests have shown that for speeds up to 65 feet per second, link belts are far superior not only to single, but even to double leather belts; but at higher speeds, the centrifugal tension in the heavy link belt decreases the allowable useful load very materially, and at speeds over 98 ft. per second, link belts cannot be economically used at all.

Tests of Leather Belts.

For speeds up to 50 feet per second, the total stress on the tight side of the belt did not exceed say 126 lb. per inch of the width of the belt, while for a speed of 98 feet per second, the total useful tension rose to 143 lbs. per inch of width of belt.

It is often asserted that belts which have the hair side to the pulley, last longer than when turned with the flesh side to the pulley. Tests made by the author show that in belts turned with the hair side to the pulley: (a) the tension ratio or ratio between the tension on the tight side and that on the loose side hardly exceeds 2, while in belts running with the flesh side to the pulley, it can exceed 3; (b) the highest allowable tension is more than 12.6 lbs. per inch less than in the case of belts with the flesh side toward the pulley. Again, the speed cannot be made more than 98 feet per second, against 164 feet with belts having the flesh side next the pulley.

This shows that it is in every respect disadvantageous to let the belt run with the hair side toward the pulley. A belt running in that way probably wears out sooner, because, as was pointed out by C. O. Gehrkens, such curvature reverses the way in which the hide grew on the animal.

Tests of High Speed Belting.

A double cemented leather belt, 1.8 inches wide, stood very well a total tension on the tight side of 370 lbs. per inch at 196 feet per second, and broke only when the tension rose to say 530 lbs. per inch. The allowable useful stress (kn) can be deduced from the formula:—

$$kn = (kT - kf) \times \tfrac{3}{4},$$

where kT is the total stress on the tight side, and kf the centrifugal tension.

Tests on Belt Fastenings.

In the tests with woven belts it was found, that, as the speed of the belt transmission increased, the allowable useful stress diminished owing to the influence of the belt fastening, which at speeds from 81 to 98 feet per second caused such vibration and uncertainty of run that it proved to be impossible to exceed the speed of 98 feet per second. The influence of the fastening is due to the following causes: (a) because the centre of gravity of the fastening describes on the pulley a semicircle, an additional centrifugal tension is developed equal to

$$kf = \frac{G}{bl} \frac{v^2}{g}$$

This additional centrifugal tension is thus a function of

$$\frac{G}{bl},$$

or weight of unit area of the fastening, and that indicates the advisability of arranging the fastening in such a way that its weight be distributed over as large an area of the belt as possible; (b) the rotation of the fastening in coming on and off the pulley produces in it a moment of torsion which in its turn produces in the belt an additional centrifugal tension. This tension becomes negligible if the fastening is made of flexible steel bands: soft steel bands lasting longer than hard ones.

THE ENGINE ROOM STAFF OF THE TITANIC.

By D.V.M.

THE engine room staff of the "Titanic," thirty-five in number, died to a man at their posts, says the report. Why should this be? What object, when doom was visible in every sign around them, could engineers and electricians have in sticking to their posts? Was it merely to light the launching of the boats?

Worked to Save Ship.

Who could doubt the answer? No seagoing engineer was ever in a breakdown without thinking out a plan, good or bad. There was a scheme amongst the engine room staff below decks to fight the inrush. The word went round that if only this spare centrifugal could be got running, if only the fitters had light in that tunnel, if only the nozzle of a compressed-air tube could be carried through that partition, if only enough sacks of stuff could be dropped over against that bulkhead door that wouldn't close, if only—a multitude of 'only's'—the enemy could be fought and baffled after all. To it they went, hammer and tongs, lever and chisel, pints of sweat and many a good round oath. Such battles have been fought before now, the ship has come to port, the engineers have become a wonder in the papers.

Of these men, no superficial sensation shall be written that rests upon a single word of theirs. A few may have floated dead to the surface; but, for the bulk of them, two miles depth of water divides them from the reporters; their lips are sealed with a pressure of two tons to the square inch; their drama is a thousand times more thrilling than anything recorded, for it remains a profound mystery.

Hugo's Ninety-Three.

Of all the duels that have been written, surely no duel could be more impressive than that in Victor Hugo's "Ninety Three," the duel between the gunner and his gun. The gunner lashed it carelessly, a storm arose; the cannon broke loose, spread chaos all over the lower deck, maimed men, knocked holes in the vessel's side, and defied all efforts to control it. The gunner, whose fault it was went down below, armed only with a crow-bar and a coil of rope. In the semi-darkness, this man fought the cannon a long duel, risking his life. He won, and the cannon was lashed up. A great personage was aboard. This personage had the marines drawn up on the quarter-deck and there he pinned upon the gunner's breast an emblem of great honor. The drums beat, the marines presented arms. 'And now,' said the donor of the honor, 'let that man be shot.'

"Titanic's" Engineers Had Similar Reward.

That, more or less, is the case of the engine-room staff of the "Titanic, except that they have committed no fault. They fight like demons, they disdain all

chances of escape, they forget everything in their contest with time and water to bring the ship to port. And then, some inscrutable power, that none of us can ever comprehend, says coldly, "Now let these men be drowned." and down they go, every man of them at his post, to the ocean bed two miles below, where fishes cannot live, and where even the germs of putrefaction will probably find life impossible. No halting halfway between top and bottom, suspended between two kingdoms like the coffin of Mahomet, as some would have it. Right down, down, down, gaining specific gravity as she descends and feels more pressure, the modern "Titanic and her engineers are among the wrecked galleons and four-deckers and Clyde-built clippers, in the museum of Davy Jones. Half-a-mile off along the bottom, perhaps, lies Don Diego Gonzalez de la Gonzalera in his state cabin, driven from his course three centuries ago and sent down also by an iceberg. Small need he has of his great jack-boots for walking. Elsewhere sits Vanderdecken who died blaspheming in his wreck, his eighteen pairs of breeches clipped tightly to his legs and his Bible held closed by a pressure of one hundred tons. If they could come visiting, and if there were light, they might wonder at the "Titanic" electrician clinging to his queer switchboard and his comrades riveted by feet or hands to any flat surfaces that they pressed against as they went down.

Fanciful Finale of the Big Ship.

The "Titanic" must have become heavier specifically as she sank, for whereas the water around her was incompressible, some of her own materials were otherwise. Wood, rubber, draperies, and fabrics of many kinds grew more compact with hydraulic pressure as she descended.

Among the first things to cave in is Colonel Astor's Thermos flask; the salt water oozes through the corks in the wine cellar; it breaks in the lids of the oil canisters in the engine-room stores. Lower down, perhaps, the electric lamps begin to pop—unheard, for no ear can work at such a pressure—the eggs in the pantry succumb and turn to omelets, bottles collapse, sardine and tomato tins cave in. Was there ever a back-pressure valve steam and water tight? If there are such rarities on the "Titanic," now woe betide her boilers. At twenty times normal pressure even steam pipes may easily collapse. The condensers may have given in much earlier, it is too dark to see. Already, water has stolen into the engineer's watch, and the man on duty in the engine room, who kept the engineer's log, has his fountain pen filled to the nib with a dark-blue fluid, enough to write a history of the wreck. Why doesn't he write?

All that is left to you and me, we do the talking of it.

We land-lubbers have to prepare plans and six months are given us to turn out a specification. If our schemes fail, what happens? We may lose a little prestige, but most of us live it down, come up smiling at Institution meetings, and in time win quite a reputation. The seagoing engineers and staff of the "Titanic" had, however, only a few minutes to get out their plans. only three hours to execute them. The price of the contract was ten million dollars and nearly two thousand lives. They failed—the contract may have been impossible, and their penalty for delay in completion—time being of the essence of the contract, was death.

All Honor to Them.

"May the earth rest lightly on them," we cannot say; it is a vain wish even of the water. "How can man die better than facing fearful odds" is the thought that naturally occurs to one, and though we cannot envy them their fate, and would rather die in our beds, we must all doff our hats in sincere reverence to the men who voluntarily went down to the bottom in their ship, fighting the common enemy rather than fighting, each man, for his life.

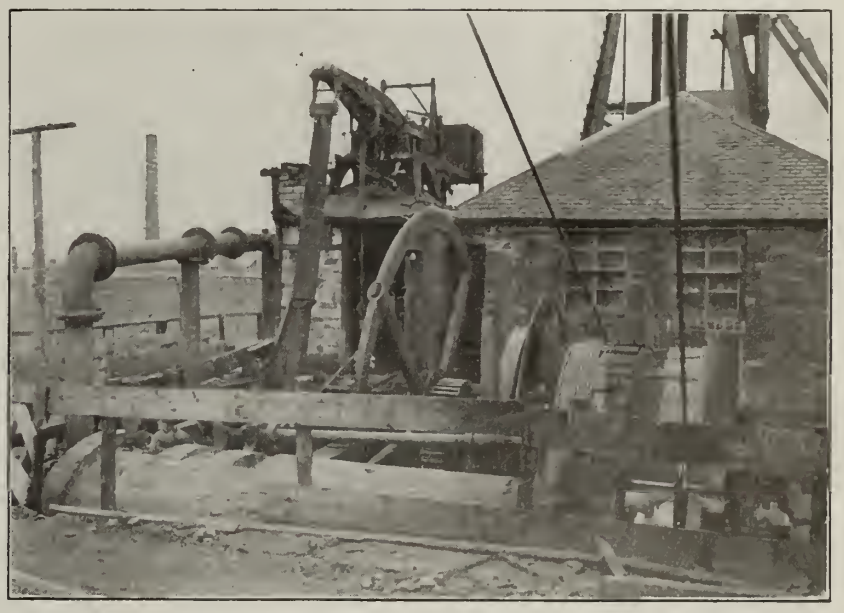
These were their names:—J. Bell, chief engineer; W. Farquharson, senior second; N. Harrison, H. J. Hesketh, junior seconds; G. F. Hosking and E. C. Dodd, senior and junior thirds respectively; L. Hodgkinson and J. M. Smith, senor and junior fourths.

The electricians were P. Sloan, chief electrician; A. S. Alsopp, second electrician; H. Jupe, A. Middleton, N. Kelly, and A. Ervine, assistant electricians.

The rest of the general engineers, from senior assistant down to assistant deck engineer, were:—B. Wilson, J. Shepherd, H. G. Harvey, C. Hodge, F. G. Coy, J. Fraser, H. R. Dyer, A. Ward, R. Dodds, T. Kemp, F. A. Parsons, W. D. Mackie, R. Millar, W. Moyes, W. M. E. Reynolds, H. Creese and T. Miller. Then also, there were boilermakers G. Chisnall and H. Fitzpatrick; A. Rous, plumber, and W. Duffy, writer.—Electrical Times.

OLD TYPE ENGINE STILL AT WORK.

AT Farme Colliery, near Rutherglen, Scotland, there is an "Atmospheric" or "Newcomen' engine, which has been at work drawing coal since it was erected in 1809. The cylinder never was bored, and is open at the top; the piston being packed from time to time with hemp, which, with a little water at the top, keeps it sufficiently tight. A man works the handle which admits steam to raise the piston and alternately water to condense the steam under the piston, so that the weight of the atmosphere may press the latter down. With the exception of one or two spur wheels which were broken by accident, no part of the engine has been renewed. It is the oldest engine at work in Scotland, and the only "Atmospheric" engine now at work in Great Britain; and is remarkable from the fact that it can draw a cage of about one ton dead load with only ten pounds steam pressure.—Glasgow Weekly Herald.



Old Type Engine still at work.

CANADA'S SUPPLY OF COAL.

CENTRAL Canada is constantly within measurable distance of a coal famine; nor are the conditions which may precipitate such a famine in any considerable degree within the country's control. This is due to the fact that all Eastern and Central Canada is dependent on the Pennsylvania fields for their supplies of anthracite coal. In view of threatened strikes of the Pennsylvania miners, the situation becomes of unusually grave importance to Canadians. It is only when such strikes occur that the public actually realizes how dependent it is upon supplies of United States coal. Again, very few seem to realize the fact that the supplies of United States coal, both anthracite and bituminous, may be entirely denied us at any time. Mr. George Otis Smith of the U.S. Geological Survey, says: "Let us keep our coal at home, and with it manufacture whatever the world needs." Should this happen, can we say that we are prepared to get along without it?

Dependence on United States for Anthracite.

According to a recent estimate, anthracite coal in the United States will be exhausted in less than two hundred years. Long before that time the cost will increase and the United States Government will see to it that the coal is not exported, but kept at home for its own needs. Let us see to what extent United States coal is sold in Canada. Enquiries sent out by the Commission of Conservation show that the following Provinces are supplied with anthracite coal from the United States:

Province-Cost to Consumer.

Nova Scotia	$6.50 to $7.00
Cape Breton	6.50 to 8.00
Prince Edw. Island	6.00 to 6.50
New Brunswick	7.00 to 8.00
Quebec	6.50 to 7.50
Ontario (East of Port Arthur)	6.00 to 7.75
Ontario (West of Port Arthur)	8.00 to 11.00
Manitoba	11.00 to 12.50
Saskatchewan	12.50 to 15.00

Our Bituminous Coal Supply.

With regard to bituminous coal, Ontario, west of Cornwall, is supplied entirely from the United States. Owing to the low freight rate, Nova Scotia cannot compete with United States coal west of Cornwall. The bituminous coal consumed in Manitoba is almost entirely from the United States, although coal mined in the Crow's Nest and Lethbridge districts finds a ready market in Western Manitoba.

From the above, it can be seen that one of the most important questions we have in Canada, at least in the Province of Ontario and the Prairie Provinces, is the question of fuel. The fuel for the Prairies Provinces will necessarily be supplied in the form of coal and briquettes from mines in British Columbia, Alberta and Saskatchewan. This, however, does not apply to the Province of Ontario, and for economic reasons stated before, Nova Scotia coal cannot find a market in Ontario.

Peat as a Subsitute.

The other sources of heat, light and power are peat, wood and hydro-electric power. Of these, peat and hydro-electric power only can be considered as substitutes for coal. With regard to peat, the Mines Branch of the Department of Mines has demonstrated the fact that peat can be successfully and economically used for fuel and power purposes. Estimating the cost per ton of peat at the bog, $2.00, and the cost of soft coal $4.00 per ton; then in car lots f.o.b., the fuel cost per brake horse-power year (3,000 hours) would be as follows:

Peat producer gas plant*	$ 7.50
Coal producer gas plant	9.00
Steam plant	36.00

Mr. B. F. Haanel of the Mines Branch, in commenting on the foregoing, states that when peat is manufactured on a large scale with machines provided with mechanical excavators and other labor-saving devices, the cost per ton of peat at the bog will be considerably less than $2.00.

While power generated from peat may be successfully used in certain localities in different parts of the country, owing to the low cost of hydro-electric power and the abundance of water-power, the chief substitute for coal which will make Ontario almost entirely independent of United States coal, will be hydro-electric energy. The Hydro-Electric Power Commission has done much to further the use of hydro-electric power by distributing to different centres, and vigilance must be exercised to see that the sources of this energy are not disposed of in such a manner as to deprive the people of power at reasonable rates.

ROPE DRIVING.

IN a paper read by Mr. R. E. Hart before the Association of Engineers-in-Charge (England), the author defined the requirements for a successful rope-drive.

The main features of an ideal rope-drive are that the diameter of the pulleys shall not be less than thirty times the diameter of the rope used, and the driving and driven pulleys shall, if possible, be of equal diameter; but where this cannot be arranged, their ratios should not be greater than 5 to 1. The distance between the pulley faces should, if possible, be not less than 25 feet, and the drive should be horizontal, with the slack side of the rope on the top. The speed may be from 2,000 feet to 4,000 feet per minute, but if too low the ropes are apt to slip, and if too high, the action of centrifugal forces affects the efficiency.

There should be a distance of from 4 to 6 feet clearance under the ropes, and these must, of course, not rub on anything. An allowance of 2 or 3 inches clearance between the bearing foundations and the sides of the pulleys must be made so as to leave room for the ropes to be put on to the pulley. The pulleys must also be accurately in line, well balanced, and the grooves exactly alike.

All gears between the prime mover and the rope-drive should, if possible, be avoided; the ropes should be kept dry, properly lubricated, and not too tight. They should all be put on at one time, and the full load applied to them as soon as possible after they are in place. Carrier pulleys, rollers, and angular drives should be avoided as much as possible.

Type of Rope.

Regarding the two types of rope generally used—namely, three-strand and four-strand—the former can be made more pliable than the latter, and it is also stronger; but these advantages are more than counterbalanced in the four-strand rope, because, compared with the three-strand, it stretches very much less, and has a larger surface in contact with the pulley grooves. It is also capable of a stronger splice. A well-made four-strand rope is, moreover, nearly as strong as a three-strand, but it requires more skill to splice it. The general opinion, now, is that cotton is the best material to use for driving-ropes, and Egyptian cotton, though a little more expensive than American, is generally preferred.

Titanic's Engineers.—Of the 35 members of the engine room staff of the Titanic who perished at their posts, 14 held chief engineer's certificates, and 8 held second engineer's certificates from the British Board of Trade Marine Department.

Sadler & Haworth, leather belting manufacturers, of Toronto, Montreal, etc., recently made a gift of a handsome gold-plated pocket pencil holder with adjustable lead, to users of their belting and to others interested in this means of power transmission Judging by the complimentary remarks of the recipients, the utility and quality of the gift is evidently only surpassed by that of the firm's product.

C.N.R. Double Truck Type Gas-Electric Motor Car

By H. A. Wilson

Canadian railroad enterprise is prominently exemplified in the accompanying article, and the success which has attended the efforts of those directly concerned will doubtless awaken widespread attention to and investigation of the possibilities of this motor in other spheres.

THE rapidity with which the internal combustion engine has arrived at its present state of perfection has caused a great many to be more or less sceptical of its reliability. However, rapid as has been its perfection of details and design, its field of usefulness has been increasing with equal rapidity. The latest application on Canadian soil

Operating and Control Equipment.

takes the form of a gas-electric car for use on the shorter lines of steam railways. The unit consists of a gasoline engine driving an electric generator which supplies current to the motors mounted in the trucks of the car.

General.

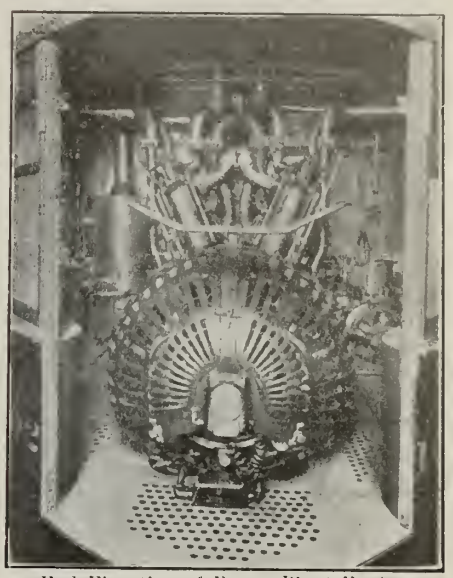
The engine is a 200 h.p. machine of the four-cycle type, having eight cylinders in two rows of four each. The cylinders are inclined from the vertical about 30 degrees, and are "staggered" so that they can all be connected to a common crank shaft. They are also cast singly with separate heads. The heads are secured by long bolts through the cylinder directly to the crank case. The valves are operated by two cam shafts; one on each side of the engine looking after its set of four cylinders. Both intake and exhaust valves are situated in the heads of the cylinders, thus necessitating the use of rocker arms to actuate them.

Fuel.

Gasolene is generally used as fuel but "Painters' Naphtha" has been extensively employed in the operation of these cars in the States. Two carburetors are used, one large and one small. The large one takes care of the engine when the car is running under ordinary conditions; the small one being used when the car is coasting or when for other reason the engine is not called upon to deliver much power.

The Engine.

The cylinders are 8-inch bore with a 10-inch stroke. The engine base or crank case, of cast iron, is fitted with large hand holes, the covers of which can be readily removed to inspect the main bearings and large ends of the connecting rods. The cylinders are of close-grained grey cast iron, developed especially for gas engine requirements. The main exhaust valve is located in the cylinder head, as before stated, but an auxiliary exhaust port in the side of the cylinder is uncovered by the piston as it reaches the end of its stroke. This exhaust port naturally assists in ridding the cylinder of all the burned gases. Each piston is of the trunk type, cast iron, and is fitted with snap rings of the same material. The wrist pins are of hardened steel, ground to size and clamped in the ends of the connecting rods. The bearings, of phosphor bronze, are in the piston. The connecting rods are of high carbon steel, drop forged and heat treated. The crank shaft is also made of high carbon steel and heat treated; with the coupling for connecting to the dynamo shaft forged integral. The bearings consist of bronze cages lined with babbitt, as also are the large ends of the connecting rods. A system of forced lubrication provides



End Elevation of Power Plant Equipment.

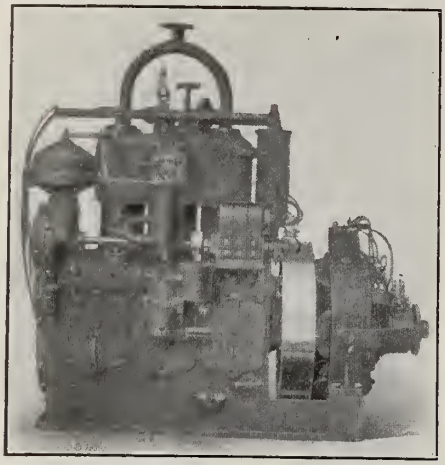
for the oiling of the cylinders and all the bearings, through ducts in the crank shaft.

Carburetor.

The gasoline tank, the capacity of which is 100 gals., is situated under the body of the car. Consequently, the level of gasoline in the fuel chamber of the large carburetor can not be maintained by gravity and a cork float as is the common custom. The supply is delivered by a pump, and the surplus taken care of by overflow pipes leading

C.N.R. Gas-Electric Motor Car.

back to the fuel tank. The carburetor is of the mutiple venturi type. Warm air is supplied to the carburetor in cold weather. It is also used to ventilate the crank case by a suitable connection. Great precaution is taken to prevent dirt, dust or other foreign matter from finding its way to the carburetor.



Gas Engine Driven Air Compressor and Lighting Generator.

Strainers are provided at both inlet and outlet of the main gasolene tank. When the engine is not in motion, gasolene can be pumped to the carburetor by hand.

Ignition.

The ignition system consists of two low tension magnetos and magnetic make-and-break spark plugs. These latter are situated in the heads of the cylinders. Centrifugal switches are provided in the ignition circuits which prevent the engine from exceeding a safe speed.

The engine is water cooled, the radiator being situated in the roof of the car and circulation obtained by the thermo-syphon system. The radiator is of the five-tube type.

Air-Compressor.

Connected to the engine is an air compressor, which provides air for the brakes and also for starting the engine, it being too cumbersome a machine to crank by hand. It consists of a single air-cooled cylinder 4-inch bore by 4¾ inch stroke, driven from the crank shaft. When the engine is running at normal speed the compressor has a displacement of 22 cu. ft. of free air per minute. An automatic governor is attached and maintains a constant pressure in the air reservoir.

Generator.

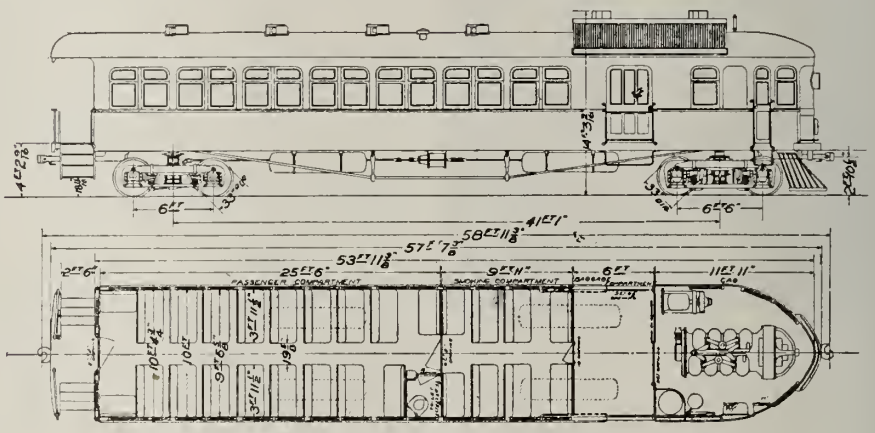
Direct-connected to the engine is an eight-pole, 600 volt commutating pole electric generator. The magnet frame is bolted directly to the end of the engine frame. The outboard bearing is ring-oiled and supported by a three-arm bracket. The design of the generator is standard with the slight alterations required to make it adaptable to the before-mentioned service conditions. This generator is designed to run at 550 r.p.m.; being the speed at which the engine delivers its rated power.

Motors.

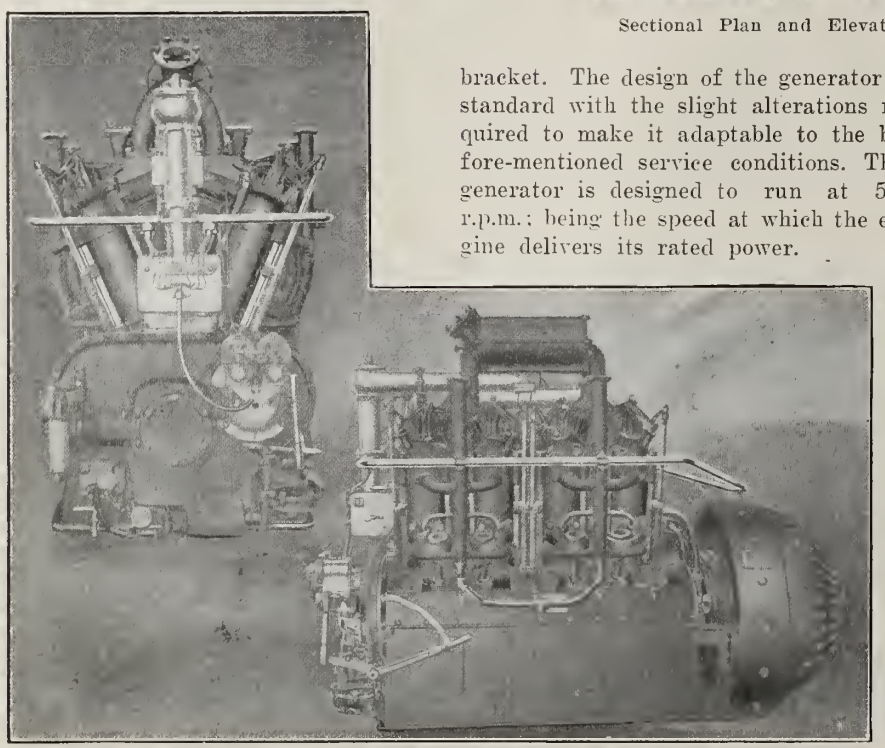
There are two 600-volt motors of 100 h.p. each, situated in the forward truck, one on each axle. Both front axles are, thus, driving axles and support from 65 to 70 per cent. of the total weight of the car; an important feature on grades or slipping rails. The motors are box frame, oil lubricating commutating pole railway type, equipped with standard gears and cases.

Control.

The control is of a very simple type; starting being accomplished by compressed air. The throttle lever, being opened one notch, delivers air to the engine and causes it not only to start but to attain nearly its normal speed. Then, as the throttle is opened wider, the gasolene is fed to the engine. The motor-control handle is placed just above the throttle lever, and is of a special type; the driving motors being placed progressively in series and in parallel, and the voltage governed by varying the strength of the generator field. A separate handle is provided for reversing the car. On the engine, a lever is provided for advancing or retarding the spark. Hand brakes are provided in addition to the combined straight and automatic air brakes. All fittings, such as hose, gauges, etc., are provided; the gauges being placed on the board immediately in front of the driver, so that he will at all times be aware of the exact pressure in his air tanks. An air whistle and a pneumatic gong form part of the equipment of the car. The ability to instantly reverse the motor furnishes a means independent of the air or hand brakes of stopping the car in cases of emergency. The electrical control furnishes an infinite number of gear ratios without change gears, which gives the car a smooth and rapid acceleration.



Sectional Plan and Elevation, C.N.R. Gas-Electric Motor Car.



End and Side Elevation of Power Plant Equipment.

Lighting Unit and Auxiliary Air Compressor.

The car has a small auxiliary engine which operates an auxiliary air com-

pressor and supplies power to a dynamo for lighting purposes. This engine is a four-cycle, two-cylinder vertical gasolene unit. The air compressor cylinder is placed between the two-engine cylinders, as shown in the accompanying cut, and is cast in a single piece, provided with a common water jacket. The diameter of the engine cylinders is 4¾ inches and the compressor cylinder, 5¼ inches; the common stroke being 6 inches. The cylinders are of the T head type, that is, the combustion chambers overhang the cylinders on both sides; the exhaust valves are placed on the opposite side to that of the intake valves and usually only require one link, namely, the push rod to connect the cam to the valve stem which is forged integral with the valve. Thus, two cam shafts are required, one to operate the intake valves and one to operate the exhaust valves. This compressor cylinder has a displacement of 45 cu. ft. of free air per minute, which is also stored in the tanks under the body of the car. The air is used to charge the tanks and start the main engine when the car has been idle for some time and there is not sufficient air remaining in the tanks to do this. The small engine is easily cranked by hand.

Directly connected to this engine is a 125-volt generator of 1½ kilowatts capacity. This generator supplies the current required by the interior incandescent lights and the 50 c.p. headlight. A centrifugal governor is provided which keeps the speed at 600 r.p.m. The connecting rods are of high carbon steel, drop forged and heat treated. The lubrication is effected by means of a constant level splash system. The ignition system consists of a low tension magneto with magnetic make-and-break spark plugs which are interchangeable with those on the main engine. Batteries are supplied to facilitate hand starting. The generator armature is bolted to the flywheel on the end of the crankshaft. The valves in the compressor cylinder are automatic in their operation and are both in the head of the cylinder.

The Car.

The distribution of weight is approximately as follows:

	Pounds.
Body	33,000
Trucks	20,000
Motors and control	8,500
Gas engines and accessories	24,000
Passengers (60)	8,400
	93,900

The total weight thus approximates 47 tons.

The car can negotiate all grades up to 1½ per cent., with comparative ease, and can be driven up to about sixty miles per hour, but will travel forty-five with no difficulty whatever. When the service demands, it will pull a trailer.

One great factor which is manifest when negotiating grades and running in deep snow is that the tractive effort of the car remains constant regardless of its speed, provided the engine speed is maintained. All the engine parts are readily accessible in case of renewals or adjustments. Then, too, the engine is mounted on the floor frame of the car and all sudden jars are absorbed in the springs and are not transmitted to the engine. Dust and dirt do not readily find their way to the reciprocating parts, thus eliminating a great deal of wear.

The maintenance of the car is very low indeed. About two miles on a gallon of gasoline is the figure arrived at after exhaustive tests over a considerable period of time. The crew consists of but two men, a motorman or engineer, and a conductor. The total operating cost in Canada will probably average about 20 cents per mile, but will vary a great deal according to local conditions, such as grades, distance between stops, traffic, etc.

The car is heated by hot water; the water being heated in a hot water heater in which anthracite coal is burned. This heater can be connected to the water cooling system of the engine when the car remains idle over night in cold weather, thus preventing the water from freezing in the radiator. As there is no smoke or cinders in connection with the power plant, the windows can be opened in warm weather. The engine is well muffled and the car runs with little noise and vibration.

This type of car is in no way an experiment, because similar types have been operated on American roads for a considerable time back. The car, however, has excited a great deal of interest and many people are closely watching its performances. On Saturday, April 13th, after trial trips had been run, it journeyed to Trenton on the new Toronto-Trenton line and ran between Trenton and Picton on the Central Ontario road which is now owned and operated by the Canadian Northern Railway, the owners of the car. On this route it is necessary to haul a trailer to care for the traffic. An ordinary railway coach was coupled on and the car carried the additional load to the satisfaction of all. The Canadian Northern intends to use the car near Quebec during the summer on tourist traffic.

CONSUMPTION OF COAL IN CANADA.

In 1911, the total consumption of coal in Canada amounted to about 24,408,000 tons, made up as follows:—9,800,000 tons produced in Canada and 14,600,000 tons imported. According to the figures Canada produces only 40.2 per cent. of the coal which it consumes. It must be noted, however, that if all the coal mined in Canada had been used in the country, it would have constituted over 46.2 per cent. of the consumption.

The consumption of coal in Canada has increased from 3,450,111 tons in 1886, to 24,400,000 tons in 1911. During the same period the coal consumption per capita has increased from 0.758 tons to 3,389 tons.

SHAVINGS AS FUEL.

SHAVINGS from the wagon shops are employed for fuel in the new 3,000 h.p. steam turbine generator plant at the Weber works of the International Harvester Company, Auburn, Ill. In the past few years six new buildings have been erected with a corresponding increase in the demand for power, with the result that the old power plant, built in 1891, was overloaded.

It has been the practice at this plant to burn all the shavings during the day as fast as made, regardless of the steam requirements. At night the fires were banked with coal. Storage bins located behind the furnaces and having a capacity of about three carloads receive the surplus shavings from the exhauster on the roof. The feed is directly into the furnaces, and as an aid to the fireman in preventing smoke a smoke indicator is placed on the wall of the boiler room. The three 600 h.p. water-tube boilers are connected to a tapering steel breeching which has a maximum section of 8 ft. by 10 ft. before it enters the 200-foot chimney. This chimney is said to be the first one built with a concrete core lined with firebrick and having the exterior faced with dovetailed brick.

The cooling of the condensing water is accomplished by spraying it through ¾-inch nozzles, 16 in number, set over the centre wall of a 600,000-gallon reservoir which is 90 feet square on the top, 15 feet deep, and has 45 degree side slopes. On account of the ground water being but 4 feet below the surface, the 10-inch concrete floor had to be reinforced for upward pressure. The centre wall is 12 inches thick at the top, and 3 feet at the bottom, reinforced for pressure from either side. An 8-inch supply pipe reduced toward the outer end supplies the nozzles under 45-pound pressure during the summer, but during cold weather an 18-inch pipe below the header pipe will

deliver the water to the opposite end of the reservoir from the suction manholes. This reservoir also provides a supply for two underwriters' fire pumps having a capacity of 1,000 gallons per minute each.

The engine room equipment comprises two 937.5 kw. steam turbo-generators for the day load, and one 100 kw. generator of the same type for the night load. Space is provided for a third large unit in the engine room, and there is also room in the boiler house for one more unit. The building is a steel frame structure of brick with a 2-inch reinforced concrete roof. Water pipes, wiring, heating pipes from the turbine exhausts and a 24-inch galvanized iron duct for shavings are carried under the street from the power plant to the shop in a 6 feet by 8 feet concrete tunnel.

AN OIL FUEL LOCOMOTIVE.

The first locomotive in Scotland to be fitted with oil fuel apparatus has just been put in service by the Caledonian Railway. The engine has an ordinary coal tender, but on the top of the tender there has been placed a tank having a capacity for 520 gallons of oil, from which a pipe is led to the furnace. The pipe branches out to either side, and allows the oil to enter through two injectors placed 18 in. apart. From these injectors the oil is sprayed into the furnace by steam, and is spread over the bars, and over a small quantity of coal which is required to facilitate combustion and to keep a fire in the furnace when the oil supply is turned off.

The oil feed is regulated by a controlling valve on each of the injectors, and the fire box is specially protected in order to withstand the intense heat. When drawing only the tender and one saloon carriage the fuel consumption is 1 1-2 lbs. per mile, and when drawing a full train it is 27 lbs. per mile. The present supply tank is sufficient for a run of 140 miles.

SMOKE CONSUMING APPARATUS.*

By G. A. Robinson.

LOUISVILLE has a strict smoke ordinance, and a very energetic and conscientious smoke inspector. The company which I represent, namely, the Merchants' Ice & Cold Storage Co., Louisville, Ky., was therefore compelled to take steps toward abating the smoke from a number of their factories.

We found upon investigation that to equip all of our hand-fired boilers with consumers would mean an expenditure of about $1,200, at least on those now in the market. We decided to design a consumer of our own and have constructed, applied and perfected it during the past winter months. We have one of these machines in operation at our Campbell and Main Streets factory, and are making preparations to install them, in our other factories where we do not have stokers. This consumer has been satisfactory in abating smoke, and, as a consequence, has been accepted by the smoke inspector. We also find that it is especially adapted to ice factories, since the automatic parts can be operated with well water.

Detail and Principle of Operation.

The principle upon which this consumer operates is the same as in most all smoke consumers, in that steam jets are placed through the boiler fronts in such a manner as to project a mixture of steam and air directly on to the fire. The supply of steam to these jets is controlled by a butterfly valve, which is opened and closed automatically by a dash pot. This dash pot is operated with well water, the supply valve of which is controlled by the fire door. In describing this machine, I will not attempt to go into detail, but will only pick out and describe a few essential parts.

In order to get the best results it is necessary that the steam jets be properly located. They should be as high above the fire as the boiler will permit, and there should be from four to six jets to a boiler, depending upon the horse power of each. It is well to arrange the jets so as to have one directly over each fire door. The jets are made by inserting a piece of 1½-inch pipe through the boiler front and front wall of the furnace, and placed on an incline, so that the centre line of the pipe would, if extended, strike the rear end of the grate bars. A ⅜-inch extra heavy pipe is placed inside of this 1½-inch pipe and extends to within about two inches of the end of same.

The end of the ⅜-inch pipe in the furnace is drawn down to ⅛-inch inside diameter, and the other end connected to a small steam header directly in front of the boilers. This header is placed so as to bring the ⅜-inch pipe in the centre of the 1½-inch pipe. The dash pot is made of standard brass pipe and iron fittings, with the exception of the cup leather piston, which can be made at any machine shop for the small sum of $3.00. All other parts of the apparatus, such as pulleys, chain, valves, etc., are standard, and can be secured from any supply house.

The work of installation can be done by the factory engineer, thus the cost of the apparatus is for the material only. We have found that this latter amounts to about $10 per boiler, where the arrangement is such that one dash pot operates two boilers. Where the front wall of the furnace has to be renewed, there is an additional expense of $10 per boiler. However, a careful man can drill this wall, provided it is not too badly decayed. We find this smoke consumer very satisfactory, easily adjusted to suit load and coal conditions, cheap to install and simple in operation.

*Paper read at the eighth annual convention of the Middle States Ice Exchange, April, 1912.

FRASER & CHALMERS, LTD.

Fraser-Chalmers, Ltd., of London, England, previously represented in Canada by Mussens, Ltd., have opened a Canadian branch office at 4 Phillips Place, Montreal. Arthur H. Sancton, formerly their engineer in Canada, has been appointed manager, and important additions have been made to the Canadian engineering staff.

The firm manufacture an extensive line of mining and power machinery, including high power gas engines, steam turbines, air compressors, steam and electric winding engines, Stumpf uniflow engines, conveyors and transporters, smelting equipment, concentrating plants cyanide plants, stamp mills and crushing machinery. They are the sole manufacturers of the Bettington Dust Fuel Boiler. This is a departure in boiler design which has been extremely well received.

PLASTICS, LTD.

Plastics, Ltd., 148 Van Horne Street, Toronto, are meeting with much success in their efforts to introduce their new product "Bakelite," which is a patented combination of formaldehyde and carbolic acid. This substance has hitherto been most widely advertised for valve discs, but the company are also doing a large business in brush holder yokes, rheostat rods and washers, arc leaves etc., and have on hand large contracts for the street railway systems of Montreal and Toronto.

In its liquid form, Bakelite is largely used for lacquering metals and varnishing wood, as it gives an absolutely impervious finish that will resist moisture, heat or acids. The company makes a specialty of colored lacquers, which while applied like an ordinary lacquer, will wear infinitely longer.

Plastics, Ltd., have a well equipped factory, where about twenty men at present are employed, and the company's prospects look extremely bright.

The Garlock Packing Co., Ltd., of Hamilton, Ont., and branches, is distributing a neat two-bladed pocket knife with electro-plated body, among steam power plant and marine engineers. Needless to say, such a useful commodity will be acceptable and highly appreciated, and those not already favored are bidden get into communication with the donors.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. V. MAY, 1912 No. 5

LABOR AND INTELLECT.

WE are all conscious that two clearly defined sections of personality exist in the world:—Labor and Intellect. We are also conscious that their representatives are known as the "operator" and "thinker" respectively, and, further, that one is a workman and the other a gentleman. Did it ever occur to you that such a condition is prolific of inefficiency, and breeds envy and discontent? Again, it needs no microscope to perceive that too little work forms part of the "thinking" section, and too little "thinking" or opportuniy for its exercise is in evidence among those dubbed workmen. Someone has said "that the mass of society is made up of morbid thinkers and miserable workers, each more or less at enmity with the other."

The nature of our employment, whatever it be, calls for much less pride than we are prone to take, and demands, instead, that we put excellence of achievement as the true measure, not only of our important selves, but of those others whose field lies in a different groove. All of us need the opportunity and should have the encouragement at our daily task whatever it be, to think as well as work constructively, and the more persistently this is practised, the less will be the suspicion attached to the motive behind innovations and the harder to determine caste in industry's ranks.

INDUSTRIAL EDUCATION.

THE subject of "Industrial Education" has recently been given considerable prominence, and like other kindred questions, has received strong commendation and support, as well as wholesale condemnation. We are afraid that the industrial, like the religious world, is originating and trying to develop too many new theories, and that instead of bringing about the calculated improvement intended, there is every likelihood of its producing harm.

Why this craze for industrial education, let us ask? Will it improve the social standing of its recipient and make him a more useful citizen of any community? Will it afford opportunity for the acquirement of such a practical knowledge, as will, together with that gained in their daily occupation, make men more immune from hardship and poverty than the existing regime of economics finds them? Industrial education and technical education are neither of them going to work the wonders so glowingly depicted. The acquirement of either of them is no simple fee-paying and enrollment picnic. The operator's enthusiasm for study bubbles over when nights darken about 6 o'clock, and freezes stiff as Christmas draws near; it being then reasoned that "all work and no play makes Jack a dull boy," and in ninety cases out of every hundred, little fault can be found with the conclusion. Industrial and technical institutions are a boon to the few—those whose inborn desire would express itself in lauding them on top of their fellows in any case, and who find in the means provided, such stepping stones as will more rapidly attain their goal.

The acquirement of wealth is just as fascinating to the student as it is to the millionaire, and we do not regard such a phenomenon with surprise, for he is cradled and brought up in an atmosphere charged with dollars. Small wonder is it then, that he shirks the long, hard road of study, and prefers to take a chance on some get-rich-quick plan. Can we blame him? We are afraid not, and until the examples from which he copies, adopt the industrial method of attaining their competence, we need not look for much success to attend a competitive and less attractive industrial school proposition.

OPERATING ENGINEER CONTRIBUTORS.

WE would again call our readers' attention to the fact that we are at all times ready to receive for publication in the Power House, not only more or less lengthy articles, but also brief, pithy letters descriptive of interesting occurrences pertaining to the day's work, of accidents to equipment, or of ingenious devices gotten out to overcome difficulties.

All operating engineers like to read of the other fellow's troubles, and how he overcame them; but far too few of them try to keep the ball rolling by sending in their own experiences. The mere suggestion that he should write for his technical paper seems to scare the average engineer. There is, however, really no reason why it should be so. What we want is ideas, not rigidly correct, grammatical writing. If our readers will send us these, we will attend to their proper shape for publication, besides paying for them at liberal rates.

When an engineer goes to the meetings of his local C.A.S.E. lodge or other association, he is not nervous about discussing with other members the happenings and troubles of his daily calling; then why not discuss these matters with a wider circle of fellow-engineers through the medium of The Power House? Those who have not yet contributed anything to our columns should make up their minds to write us a short letter about the next thing they "get up against," and we venture to prophesy that they will be agreeably surprised to find how much less difficult it is than they had supposed. "The proof of the pudding is in the eating," and if proof were wanting that writing for The Power House is a pleasant, as well as a profitable occupation, it is to be found in the fact that we have readers who have been sending in contributions at regular intervals for a number of years.

Cost Accounting in Relation to Industrial Power*

By J. W. Helps, Toronto

No more prominent feature, and one to be found in every department and sphere of business management, can be pointed out than that of cost accounting; it having been clearly recognized, that only by a true application of the latter can the keen competition of commercial life be successfully negotiated to-day. Not the least important section is that of power cost accounting. A careful perusal of the paper will serve to guide those interested and affected to secure a better, perhaps more reliable and more complete understanding of the subject.

THERE was a time when the world was moderately easy going—when accuracy in cost questions did not very much matter. That time has on account of age died a natural death and been decently buried. Its place has been taken by a time of stress and competition, when everything counts, and when the only man who can hope to achieve success is the one who is entire master of the situation. There is probably no case where cost matters so much, as it does in the question of power. The importance of this is too obvious to need argument.

At the same time it is at least equally important that we should have a proper conception of what should or should not be charged to the cost. This will become apparent the moment we begin to analyze the supposed costs of various installations. One man omits allowance for interest on capital invested; another omits depreciation costs; another forgets the repairs, the oil, waste and supplies or insurance, whilst another simply puts down coal, oil and wages, as representing total cost. It is not enough to say, "Some of these things would have to be paid even if you used some other form of power." The point is—what is this costing? The "something else"—whatever it may be—must bear its own cost in the same way.

Horsepower Cost per Year.

The man is frequently met who talks about power costing so much per horsepower per year. This is, perhaps, the most uncertain, unsatisfactory and misleading expression imaginable. Two considerations will suffice to show it so. An article appeared in a technical paper recently on steam power costs, and the supposed results in certain cases were brought down to a basis of "— per horsepower per year." On examination it was found that whilst reasonable care had been exercised in making the costs inclusive, the whole value of the deduction was destroyed by an error. The engine was described as 200 horsepower; the total cost obtained was divided by 200, and the result described as the cost per horsepower per year. Now, the maximum load on that engine might have been 40 or 70 per cent., although certainly not 100 per cent.

Again, in one case the plant is in operation for eight hours daily for five and one-half days in the week; in another case for ten hours daily, and six days in the week; and in a third case for sixteen hours daily for five and one-half days. Assume these plants to be identical in construction, doing exactly similar work, under exactly similar conditions—excepting only in the matter of time. It will be seen at once, then, that

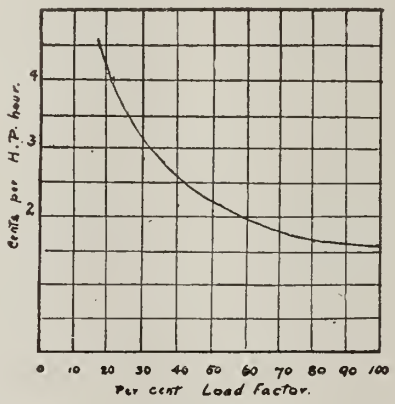


Fig. 1.

although the efficiency will be as great in either case, yet the annual costs will vary. More than that, the cost will not vary exactly as the number of hours.

Take the first and third cases mentioned. The operating time in the latter is twice that in the former. But the cost will not be double, in fact, it will be found that the shorter runs—forty-four hours, will cost somewhere about two-thirds of the longer run of eighty-eight hours, obviously because the fixed charges remain fixed. For the same reason, the price per horsepower hour will be less in the latter case than in the former.

Three Important Considerations.

1.—Each case must be treated on its own merits.

2.—That in order to arrive at any useful figures, we must carefully discriminate between fixed costs and operating expenses.

3.—That under ordinary conditions the cost per horsepower hour varies with the number of hours during which the plant is being operated.

First Consideration.

It is probably not too much to say that there are not two cases, where all conditions exactly correspond. One of the most important features is that of the load factor. This will vary from 10 per cent. in some cases to 85 per cent. in others. The effect is seen in the accompanying diagrams, Figs. 1 and 2.

Local conditions also play an important part. The engine house may be occupying very valuable space, whilst in other instances there may be special advantages in matter of fuel, etc. What other special circumstances there are can be ascertained, and usually exist.

Second Consideration.

We come now to the actual accounting. What are fixed costs? In a word, those which exist as annual charges, irrespective of the amount of use of the plant. Operating costs, on the other hand, are those more or less dependent upon the amount of work done. In order to get anything like an approximately correct estimate, we have to go right back to the time of the purchase of the plant and ascertain the cost of the following items:—

Boiler Room.

1. Engine and boiler house (or if included in building the additional cost on building in consequence of such inclusion.)
2. Boiler and stoker.
3. Foundation.
4. Setting.
5. Stack and flues.
6. Pumps.
7. Heaters.
8. Injectors.
9. Valves and gauges.
10. Installing.
11. Covering.

Pipe System.

12. Pipes.
13. Covering.
14. Valves.
15. Drains.
16. Steam traps.
17. Sundries.
18. Installing.

*Abstract of paper read before the Central Railway and Engineering Club, Toronto, April, 1912.

Engine Room.

19. Engine.
20. Foundation.
21. Installing.
22. Condensors.
23. Pipes, valves, etc.
24. Installing.
25. Sundries.

Distributing System A.

26. Belts.
27. Shafting.
28. Pulleys.
29. Hangers.
30. Couplings.
31. Sundries.
32. Installing.

B.

33. Dynamos.
34. Switchboards.
35. Wiring.
36. Motors.
37. Motor starters.
38. Sundries.
39. Installation.
40. Engineering and supervision.
41. Transportation, teaming and incidentals.

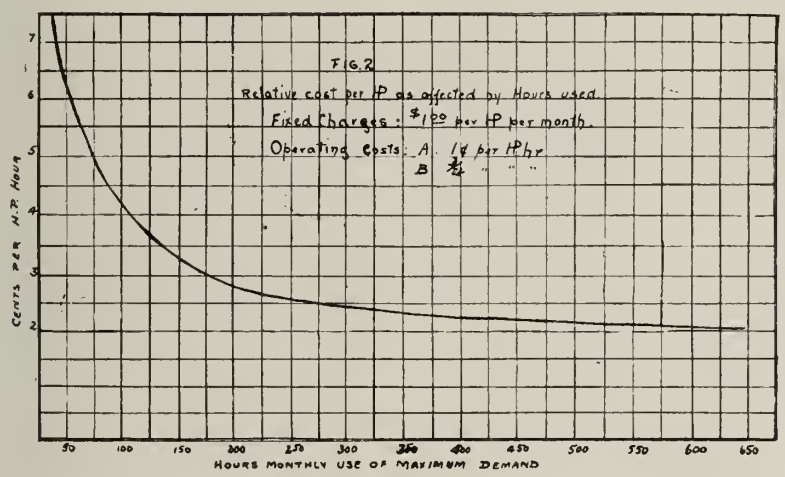


FIG. 2
Relative cost per HP as affected by Hours used.
Fixed Charges: $1.00 per HP per month.
Operating Costs: A. 1¢ per HP hr
B ½ " " "
CENTS PER H.P. HOUR
HOURS MONTHLY USE OF MAXIMUM DEMAND

Fig. 2.

The sum of these items will give us the initial capital expenditure, upon which to base the principal items in our fixed charges. These are made up of:—

A.—Charges on account of capital.

B.—Other annual charges.

Having thus ascertained the capital involved we now have to take our costs arising therefrom, including:—

A.—Interest on capital investment—6 per cent.

B.—Depreciation. This will vary on different items, depending on the life of the article referred to. For instance, fourteen years is generally allowed for boilers, but for the stack, fifty years may be allowed in some cases; this would mean 7 per cent. in the former case and ½ per cent. in the latter. The plant may, of course, outlive these ages, but in that case the difference is more than offset by the disadvantage and risk of obsolescence.

C.—Profit. Many experts think that 15 per cent. on the capital invested is a very considerable amount to charge under this head, but the principle on which this charge is based is that the manufacturer is justified in charging to the plant account only the same percentage of profit as he would actually make if that amount were invested in another department of his business, as shown by the actual profit he is really making.

The other annual charges will include:—

D.—Insurance. On the plant, for employers' liability and the proportion by which other insurances are increased as the result of having a steam plant on the premises.

E.—Taxation. This is another uncertain quantity which can only be assessed as circumstances warrant. Many experts charge 2 per cent. on 75 per cent. of the cost value of the plant, but in some cases the taxation on a property will be greatly increased by reason of an expensive steam plant having been installed.

F.—Repairs. This will in most cases be taken care of fairly well by an annual allowance of 2 per cent. on the total investment. Some engineers, however, prefer charging 1 per cent. on the capital investment, and add on 2 per cent. to the total operating costs. Leaving the accuracy of the figure aside, there appears to be some logic in this method.

G.—Land Rental. As the value of real estate is liable to vary from year to year, the fairest way is to charge a rental equivalent to a percentage of say 6 per cent. on the value of the land during the year in question. When the boilers and engines are included in the main building instead of in a separate engine house, this charge item takes the form of a rental for floor space.

The operating costs will need little or no comment. They include:—

H.—Coal.

I.—Water.

J.—Ashes (removal).

K.—Oil and waste.

L.—Supplies.

M.—Wages.

N.—Executive attention and office costs.

The last mentioned is often overlooked, but such is always an error. There is necessarily an executive and office staff to every business, and their costs must be borne by the departments. Some proportion of this is chargeable to the power. It is the practice with many engineers to make a little discrimination in the operating costs. It is found that the first few hours in each day will cost a little more than the later hours, for obvious reasons. Hence a little higher proportion is allowed for one hundred hours each month than for all succeeding hours. Thus two rates are used in Fig. 2, marked A and B.

(Continued in next number)

PLANT WRECK.

ON May 2, the power plant of the Chambers Electric Light & Power Co., at Truro, N.S., was wrecked by the explosion of a flywheel. There were no lives lost, but the monetary loss was large.

According to press reports, the flywheel burst at 7.15 a.m., the flying pieces destroying the dynamo and wrecking the power-house interior. One piece, weighing 172 lbs., was blown through the roof, landing in front of St. Andrew's church, 270 yards distant. Another piece, weighing as much, was not only blown through the brick wall of the power house, but forced its way through another brick wall into an adjoining furniture store, while a big fragment tore through the power-house wall and then through the wall of a laundry adjoining.

The president of the company was just about to enter the door of the power house when the accident took place, and the concussion hurled him several yards away, unhurt. An employe dashed into the building amid falling bricks and plaster and debris and shut off the steam.

As the company had duplicate emergency engines and dynamos, the light and power service was not interrupted.

The Gould's Pump Co. have moved their Montreal office to 324 Coristine Bldg., and their Toronto office to the Union Bank Bldg. Mr. J. M. Mackie, Montreal, will be the general manager as before, and Mr. E. Storey, late with the Jones Underfeed Stoker Co., will be manager for Ontario.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

RELIEF-NOZZLE OPERATING MECHANISM.

By T. H. Crosby.

IN water-power plants using impulse wheels the governor may operate in one or two methods in order to hold speed constant.

First, it may be arranged so that on a sudden decrease in load it will operate a deflecting nozzle which allows more of the stream to miss the wheel and at the same time operates the needle nozzle or other valve, shutting off the flow water in the pipe-line slowly without causing an undue rise of pressure. Second, the governor may shut off the water passing the nozzles directly; letting a relief nozzle take care of any tendency to abnormal pipe line pressures if the pipe be long and liable to water hammer.

Sketch and Detail.

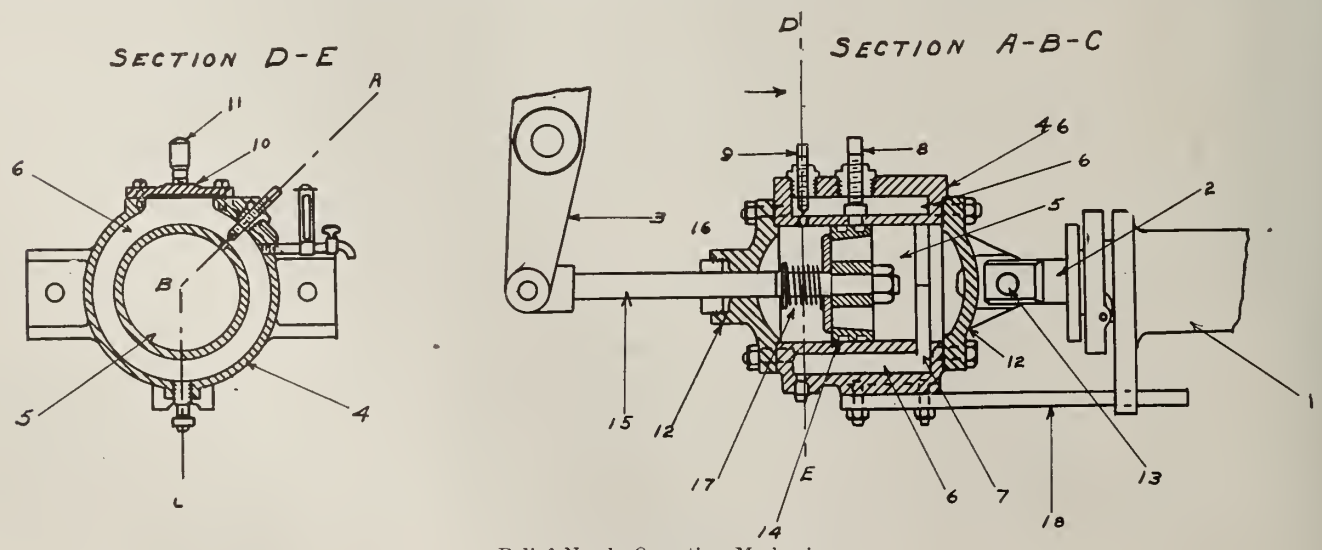
The accompanying sketch shows in section a device used to open and close such a relief nozzle. This form was installed on a 10,500 horse-power Doble water-wheel in a power plant in Western Canada. The apparatus consists of a cylinder filled with oil attached directly to the needle of the relief nozzle and a piston connected by a rod to a crank on the rocker-shaft operated by the governor, to open and close the main needle nozzles. About the cylinder is an annular space throughout its length, and open to it at the end next the relief nozzle. There are also two holes through the cylinder wall to this annular space, one about half way along the cylinder and the second near the end toward the rocker shaft. The opening provided by these holes or vents may be adjusted by the setting of the valve screws shown. The piston is built like the plunger of a single acting pump and will allow the oil to flow through it only from right to left. The function of the other parts is evident from the list given.

Operation and Regulation Features.

Regarding the operation of the device, consider first the case of increased load. Here, the plunger moves to the right, due to the rocker-shaft being operated by the governor to open the main nozzles, and remains in this new position without affecting the relief nozzle. The other case, that of sudden decrease of load, causes a rotation of the rocker-shaft in the opposite direction and consequently the piston is moved to the left. In this instance, the oil cannot escape through the piston but only through the vents in the cylinder wall. If the motion be sudden, the cylinder will move with the piston and open the relief nozzle by drawing back the needle. If the motion be slow, the oil ahead of the piston will have time to escape through the vents to the annular space about the cylinder and allow the cylinder to remain in the same position without opening the relief valve.

As the rise in pressure in the lower end of any pipe line or penstock depends upon the rate at which the velocity of the flow of water is decreased, it is readily seen that a relief nozzle should open in proportion to this rate, and also that it should close again as soon as the pressure becomes normal in order to prevent a waste of water. The first of these requirements is readily met from the operation described above and the time taken to close the relief valve after its being opened is roughly proportional to the distance opened, which will allow the excess pressure to be relieved before the valve is closed in any case.

It may be noticed, also, that the vent, mid-way along the cylinder, will at times of light load—small nozzle openings—not be in a position to allow the escape of oil. This will cause the



Relief Nozzle Operating Mechanism.

movement of the cylinder and relief nozzle needle to be more positive, that is proportional to movement of main nozzles. Thus, it is, when the main nozzles become nearly closed and any movement towards closing them causes the greatest throttling of the stream, that the relief nozzle is most likely to open. With the main nozzles wide open, the same movement of the needles will not cause so great an effect on the velocity of the water in the pipe and consequently not so great a rise in pressure as when the nozzles are nearly closed.

By using suitable oil and proper adjustments of the vents from the cylinder, any degree of sensibility required within a wide range can be obtained.

List of Parts.

1.—Auxiliary relief nozzle.
2.—Needle.
3.—Lever.
4.—Relay element.
5.—Cylinder of relay element.
6.—Oil reservoir of relay element.
7.—Oil port.
8.—Valve screw to adjust flow of oil.
9.—Valve screw to adjust flow of oil.
10.—Cover of oil reservoir.
11.—Air inlet.
12.—Cylinder head.
13.—Pin connection of relay element to needle.
14.—Piston.
15.—Piston rod.
16.—Valve to close holes in piston.
17.—Spring to hold valve against piston.
18.—Guide rod.

VALUE OF WATER POWERS.

WATER-POWERS are daily becoming of increasingly great economic importance. During the last few years there has been special effort made on the part of large interests, both in Canada and the United States, to secure control of water powers in strategic positions. Mr. Gifford Pinchot has drawn special attention to the fact that year after year, the paid attorneys of large corporations were appearing at the seats of the Federal and State governments endeavoring to have restrictions removed which would facilitate the easy acquisition of coveted water-power privileges. In the recently published report on "The Water-powers of Canada," the Commission of Conservation emphasises the fact that the number of water-powers desirable from an economic standpoint are much less than popularly supposed.

In view of the facts above mentioned, every community should be alive to the power question as affecting its particular locality. The Commission of Conservation is at persent working upon a report which will deal with the water-powers of Western Canada. The province of British Columbia is especially rich in water-power posibilities, but nevertheless even here great care requires to be exercised respecting the conservation of this resource. There may be many water-powers in a community, but, amongst these only one or two may be suitable for development on a scale sufficiently large to keep the cost of the developed electrical energy reasonably low. For example, around the Shuswap Lake district, and the valley of the Thompson, with its North and South branches, the possibilities of the Adams river are of great economic importance to the welfare of the whole community. In such instances the authorities should not permit any development to take place except under terms and conditions respecting period of lease, and absolute provision for the regulating of the prices at which power shall be supplied within the territory that may be covered from such a development.

These questions are of very great moment, and careful study of them will, no doubt, contribute much to the welfare of communities whose progress is, in any way, associated with the development of power.

DEPARTMENT OF THE INTERIOR, WATER POWER BRANCH.

A CHANGE has taken place in the organization of the Department of the Interior at Ottawa, by the creation of a water power branch and the appointment of Mr. J. B. Challies as superintendent. The new branch is charged with the responsibility of all matters connected with the administration of water powers in Manitoba, Saskatchewan and Alberta, and also of all matters relating to irrigation, reclamation and power in the railway belt of British Columbia.

In addition to a head office organization at Ottawa, the new branch comprises an extensive corps of experienced field engineers, having headquarters at Winnipeg, Man.; Calgary, Alta., and Kamloops, B.C., who will engage in reporting on water power projects and the investigation of the water resources of the west, with particular reference to power.

Mr. C. I. Printz, consulting engineer, 121 Delaware Ave., Toronto, has been appointed Ontario representative for Messrs. Escher, Wyss & Company.

INEXPENSIVE METHODS OF LOCATING LEAKS IN WATER MAINS.

IN the discussion of a paper on water waste surveys, read before the Illinois Water Supply Association, two inexpensive methods of locating leaks in water mains were described.

Mr. Wheeler stated that he found the problem of locating leaks one of the most interesting presented in waterworks operation. In clay soil, a boring is made down to the pipe every 16 ft. with a 2-in. augur. An audiphone is next placed on the top of the shank of the augur. A leak can then be heard, if located within a rod of the augur on either side. In this way, the entire system of mains may be gone over with comparatively little expense, and a great deal may be accomplished in the way of locating leaks. In gravelly soil, where the augur cannot be used, simply take a ½-inch rod and point it so it will drive easily.

Mr. Slocum described a method he has employed, as follows:—We made a survey of the system in Belleville last fall by dividing it in sections and passing the water through a meter from one fire plug to another in a different section. By taking a large section first and then cutting it down we arrived at that section showing the greatest loss. Again, by having the sewers examined, we were quite frequently able to locate the leaks in certain plugs. Then, by testing at the curb boxes we have been able to locate the leaks right on a broken service. This is a comparatively cheap way of doing the work, although not as accurate and thorough as it might be; but if there is any serious trouble on the line we are very apt to find it.

BRITISH COLD STORAGE AND ICE ASSOCIATION.

The British Cold Storage and Ice Association has elected Mr. J. T. Milton, the chief engineer-surveyor of Lloyd's Register of British and foreign shipping, as its president. This is the first time that the Association has had an eminent engineer at its head, its previous presidents were leading representatives of the frozen meat importing and refrigerated shipping trades. Lloyd's Register is, of course, the inspecting and classifying authority for the great fleets of liners which carry frozen meat from and to all parts of the world, and Mr. Milton, as the Register's chief expert, and one who has had many engineering honors conferred upon him for contributions to engineering institution literature, may be well expected to further the interests and work of the Association.

Factory Lighting

THE need for an improved artificial lighting in factories and workshops has previously been emphasized in our columns. It would seem likely that factory owners will be forced by legislation to improve existing means and methods of lighting their workshops. That the direct physiological effect of good lighting is an improvement in the quality and quantity of the output of the various operatives is fairly obvious, but there is another very serious aspect of the case which factory owners would do well to consider. Inefficiency and insufficient lighting is the cause of a large number of accidents; this being borne out in statistics published by Government departments, and further substantiated by the opinions of Insurance companies. In fact one large company places poor lighting first amongst the general causes of accidents.

It is not a very difficult matter to arrange a successful scheme of workshop lighting. All that is required is the application of a few common-sense principles and to bear in mind the fact that the light should fall upon the object and not upon the eye; at the same time securing even illumination with freedom from heavy shadows and streakiness. There are now available a large number of specially designed reflectors and fittings for interior lighting which distribute the light in a certain definite manner; by spacing them properly it is possible to carry out the installation so that a successful lighting scheme will result. This need not entail any extra cost over the ordinary installation in which enamelled iron shades of the common pattern are used in an indiscriminate manner. Apparently the sole virtue of this class of shade is its cheapness; it does not shield the eye from the bright filament of the lamp, and owing to variations in the manufacture, no two enamelled iron shades will be found to distribute the light in an exactly similar manner.

Good lighting means cheap lighting. There should not be and need not be any waste. As regards the quantity of light, this depends entirely upon the class of work which is being carried out in the factory. Some trades, for example lithographing, engraving, etc., require a large amount of light, whereas in foundries it is much smaller. Expressing it on a per capita basis, even if so large a quantity of light as 100 c.p. per man is allowed, this at 4 cents per unit will only entail a cost of about ½ cent per hour. In the case of a skilled workman, earning say 25 cents per hour, it needs very little improvement in his output and quality of work for this cost to be recovered.

Considerations to be Accounted.

There are two considerations to be dealt with in all factories and workshops. First, with reference to the question of general lighting in shops, and secondly, the provision of local lighting for machines, lathes, tools, etc. In other cases, the point to be remembered is that the cost of carrying out the lighting scheme properly is small compared with the risk that is run of accidents, which, as has been mentioned, are largely the outcome of inefficient lighting. There is also the danger of the work being spoilt through inefficient illumination. Special trades and situations each require individual consideration. Some trades call for good general illumination only, others require in addition to general lighting, local lighting.

Illuminating Mediums.

The general illumination can be effected in three ways. (1)—by arc lamps; (2)—by mercury vapor lamps; (3)—by incandescent lamps. The first method is very suitable for large areas where the lamps can be installed high up. In general there are three types of arc lamps to be considered. (1)—Flame lamps burning mineralized carbons; (2)—enclosed lamps burning pure carbons; (3)—open lamps burning pure carbons. The uses of each may be summarized generally as follows:—

Flame lamps for very large interiors or for exteriors of shops where great illumination is required from an advertising standpoint. Enclosed lamps for small engineering shops and foundries where considerable intensity of the light is not required to be very great and the question of maintenance, the re-trimming of the carbons, is a difficulty.

Open type lamps have been largely displaced by the flame arc, but they may be used for large interiors where the ceiling is lofty and the walls are light colored and therefore of good reflecting power.

Mercury vapor lamps can be used for general lighting with excellent results wherever the color of the light is not objectionable. These lamps give, of course, a peculiar bluish white light. The principle upon which the lamp works is such that the light is diffused and softened to a much greater extent than with any other form of artificial light, although the nature of the light is such as to be unsuitable for color matching. They are exceedingly cheap to run, but somewhat expensive in first cost. A c.p. of 1,200 can be obtained from these lamps with energy at 6 cents per unit, at a cost slightly exceeding 2 cents per hour.

As a comparison, it may be mentioned that this is approximately 25 per cent. less than the cost with an open type flame arc lamp, but it must be remembered that with the mercury vapor lamp there is no additional expense to be added through the cost due to the labor required for re-carboning. Incandescent metallic filament lamps, because of their simplicity and the nature of the light, will probably be found most suitable when ordinary conditions only have to be considered. With their cost for current taken into consideration, the renewal of the lamps would be approximately 50 per cent. more than with a mercury vapor lamp.

Fitings and Reflectors.

The main factor in successful or otherwise lighting by incandescent lamps is the class of fitting or reflector with which they are used. In addition they should be properly spaced. The reflector has a most important effect upon the general illumination, and if the case of one particular pattern is considered it will perhaps lead to an understanding of the results obtained by a reflector when used in conjunction with an incandescent lamp.

With different shapes of reflectors the distribution of light can be altered according to varying requirements. For example, whilst one particular type of reflector would increase the candle power in a downward direction, directly below the pip of the lamp, another type of reflector is so arranged that the light is thrown in a sideways direction to the greatest extent, thus distributing the light over a much larger area. It is obvious that these various types have different applications which vary according to whether a diffused or an intense bright light in a certain direction is required; say for example, over a printing machine.—Electrics.

CONCENTRATION OF ENERGY.

A SAVING of about 200 million tons of coal annually is estimated by Mr. Samuel Insull as the result of a general concentration of energy production in the United States. When addressing the American Institute of Electrical Engineers, Mr. Insull made further calculations which ought to encourage and inspire the growing number of engineers who are bestirring themselves to awaken public opinion on the question of fuel economy. In New York, the total load on several systems of generation is 678,000 k.w. If they were consolidated, the diversity factor would come into operation to reduce this amount by 47,000 k.w. In Boston, Mr. Insull estimates that if the lighting and traction loads were dealt with under one system the maximum demand would

come down from 111,200 k.w. to 95,400 k.w. Further great economy would, of course, result if the steam railway services were brought into the scheme.

The ensuing discussion was enlightened by contributions from some of America's foremost authorities, and one of the most remarkable was that of Professor Dugald Jackson, who declared that such concentration of energy would be necessary to maintain the cities of the future as suitable places for habitation.

RAZING A LARGE CHIMNEY.

THE third largest chimney in Newark, N.J., which belonged to an abandoned works, and was 22 feet in diameter at the base and 183 feet high, was recently razed. The chimney was built 20 years ago, and was purchased by a contractor for the bricks of which it was composed.

It was necessary in razing the chimney, that it should fall in a certain direction to avoid damaging the adjacent property. In making preparations for its fall, bricks were removed from the base and replaced by timber supports; the opening extending about half way round. When all the supports were in position they were saturated with kerosene and set on fire. After burning about 20 minutes the wooden base gave way and the chimney rocked to and fro before it finally fell. In its fall it broke into six large pieces of approximately the same height, and all struck the ground within 100 feet of the base.

SUPERHEATED STEAM.

IN connection with the experiments on a water-tube boiler with special reference to superheating, described by Mr. Harold E. Yarrow at the recent meeting of the Institution of Naval Architects, Mr. Richard W. Allen, of Messrs. W. H. Allen, Son & Co., Limited, Queen's Engineering Works, Bedford, states that during the last ten years they have had experience in their power house, in working four Babcock and Wilcox boilers, each fitted with a horizontal U-tube superheater. The boilers are constructed for 300 lbs. of steam, but the average working pressure has seldom exceeded 230 lbs., and the average steam temperature recorded daily varies between 435 and 485 deg. F., according to the load. He says they have experienced little or no trouble with these superheaters and no accident owing to the tubes becoming overheated. A new Babcock and Wilcox boiler of the three-drum land type, recently put in operation, is also fitted with a horizontal U-tube superheater and is provided with a horizontal damper the width of the whole boiler, similar to that described in Mr. Yarrow's paper. This damper is controlled by hand in such a way as to prevent any of the gases from passing through the superheater when saturated steam is required. The arrangement is simple and has been found of the greatest advantage, as it enables the superheat to be controlled from 0 to 150 deg. F. Up to the present no trouble has arisen from the damper, which is constructed of cast iron, becoming overheated or getting out of shape. In regard to the suggestion of adopting superheated steam for auxiliary machinery, such as high-speed forced lubrication engines for electric lighting, circulating pump engines, and fan engines, Mr. Allen sees no difficulty provided every care is taken on the design of the steam cylinders and in the selection of the materials, which is of the first importance. The experience his firm have gained by the use of superheated steam with a pressure up to 220 lbs., and a total temperature of 550 deg. F. in connection with reciprocating engines of various types and sizes for land purposes has been entirely satisfactory, and he can from the results of many steam consumption trials confirm the percentage of saving from superheat as given by Mr. Yarrow, whose paper he trusts will have the effect of causing the adoption, in the near future, of superheated steam in marine work also.

SECRET RIVETING.

By T. R.

A SIMPLE but positive method for riveting name plates to machines, or for other similar propositions in which a two-piece connection has to be made, is described as follows: Drill the holes in machine body nearly to depth required, then remove drill and grind one facet off centre. Now drill the holes a trifle deeper; in doing which, with the centre of drill out of centre, the bottom of the holes become countersunk. Again, by grinding still more off the drill, the holes will be well undercut at the bottom. If the holes in the face of the nameplate be countersunk and rivets of same material as the latter be used, it will be exceedingly difficult for anyone to determine the method of fastening unless they are aware of the mode of procedure adopted.

AGENCY APPOINTMENTS.

The Engineering Specialties Co., of Toronto, have appointed the following well-known firms as agents for their Everlasting Blow-Off Valve:—

H. L. Peiler & Co., Montreal, P.Q., Agents for Quebec.

A. R. Williams Machinery Co., of St. John, N.B., Limited, agents for the Maritime Provinces and Newfoundland.

P. D. McLaren, Limited, Calgary, Alta., agents for Alberta and Eastern British Columbia.

THE PUBLIC'S DEBT TO LABOR.

WHEN we review the field of human endeavor, we find that many of our national glories have been produced at an unnecessary sacrifice of human labor. To the laborer and the mechanic belongs the honor for producing the vehicles in which we ride, the clothes we wear, the buildings in which we live and work, and the machinery that plays an important part in everyday life. Still the lives of these men are considered of little value in the mad rush to excel in commercial competition. In the race of the industrial juggernaut, human lives are maimed and crushed, figures stunted and deformed, bodies poisoned, women made widows and children orphans.

Capital has become indifferent to the interests of labor in many cases, but thanks to measures instituted by organizations that have the welfare of the laboring classes at heart, remedies to eradicate many evils have been brought into action of late and it is to be hoped that such work may continue until a standard that insures the fullest protection possible has been reached.

More efficient guarding of machinery in factories is required, and in this connection, an increased demand for more factory inspectors and a more efficient organization of the factory inspection force is desired. There is great need for better ventilation in our factories and steps are being taken in the introduction of measures that will make better ventilation compulsory in buildings where workmen are congregated.—Nat. Coml.

INDUSTRIAL PROGRESS.

The fact that Armour & Co. have set aside a fund of a million dollars for the inauguration of a pension plan for employes is significant, not so much as regards the amount involved, but rather as exemplifying the tendencies of our great industrial factors in the direction of humanitarianism. There are 55,000 employes of Armour & Co. A million dollars, perhaps, will not go very far, but that is not the point. It is rather the fact that the policy of the directors of one of the world's great enterprises sees fit to reward conscientious service by eliminating the worry for future livelihood. Such movements in the great American industrial field will do more to eliminate impractical socialism than all the propaganda that could possibly be advanced by dreams of Utopian impossibilities!

THE READERS' POINT OF VIEW

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

INTERNAL COMBUSTION ENGINES.

By A. F. White.

THE object of this article is to describe a few of the various methods used for silencing the exhaust from an internal combustion engine; well knowing that the subject is a very interesting one to a good many readers, it being often necessary to devise some means of quietening a noisy barking exhaust even after the engine has been working a number of years, owing perhaps to the district becoming thickly populated and complaints made by neighboring tenants.

The effective silencing of exhaust gas emission from a large gas engine is sometimes difficult and calls for expert treatment before absolutely satisfactory results can be obtained; an arrangement found all that can be desired in one particular case frequently failing when applied to an apparently similar installation. After the gas has performed its useful work in the cylinder of an engine it must be allowed to expand freely into the atmosphere, and as there is a pressure of about 25 to 30 pounds per sq. inch at the point of release, or at the opening of the exhaust valve when working with a maximum explosive mixture, this would cause a very loud report if allowed to escape direct from an exhaust pipe of uniform cross section.

Points to be Noted in Exhaust Silencing.

In scheming out an arrangement for effective exhaust silencing it is necessary to bear in mind that such quietening should if possible obviate the use of water injection into the exhaust pipe, as this usually means expense. Of still more importance the method of silencing should not create back pressure, a synonym for incomplete evacuation from the cylinder and consequent dilution of the succeeding charges.

The good working of an engine whose cylinder is properly and completely evacuated at each stroke is fully recognized, indeed scavenging by inducted upward draught through a long vertical pipe is a feature aimed at by some makers. On account of the inertia of the exhaust gases which escape at a very high speed a remarkable depression is created inside the cylinder if the exhaust outlet is carried through a straight pipe free from bends and from 20 to 30 feet long. This has the effect of clearing out all the remaining gasses from the cylinder and allowing a larger quantity of pure mixture to be drawn in, thereby insuring that the efficiency will be much higher than with a diluted impure charge.

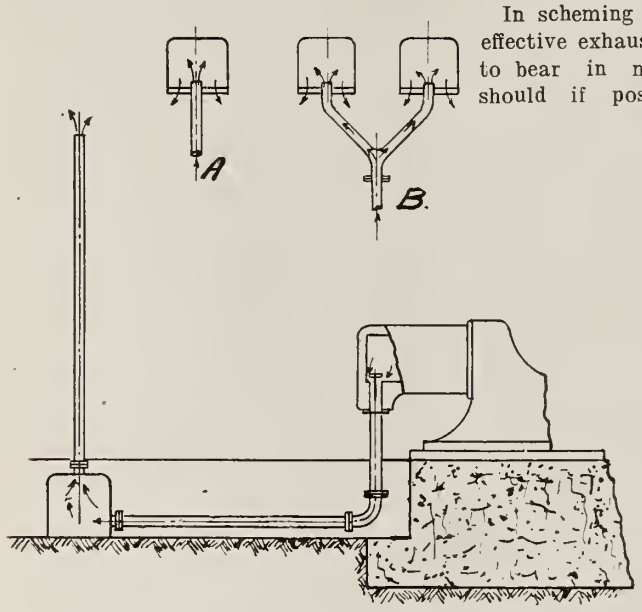


Fig. 1 — Expansion Box or Muffler.

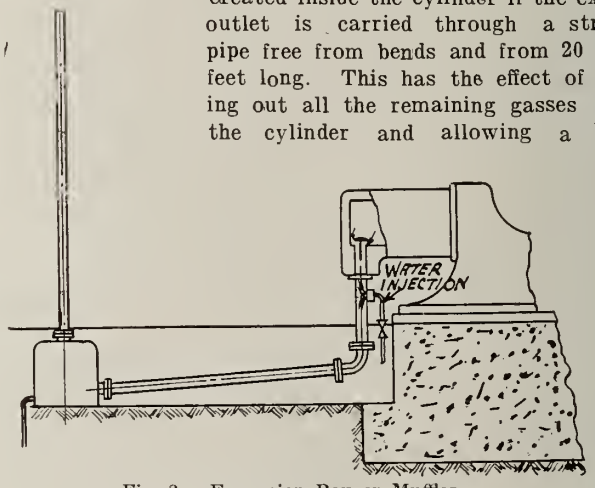


Fig. 2 — Expansion Box or Muffler.

Expansion Box or Muffler.

Fig. 1 shows the use of an expansion box or muffler which is usually the standard equipment and the only device provided to lessen the noise of the ex-

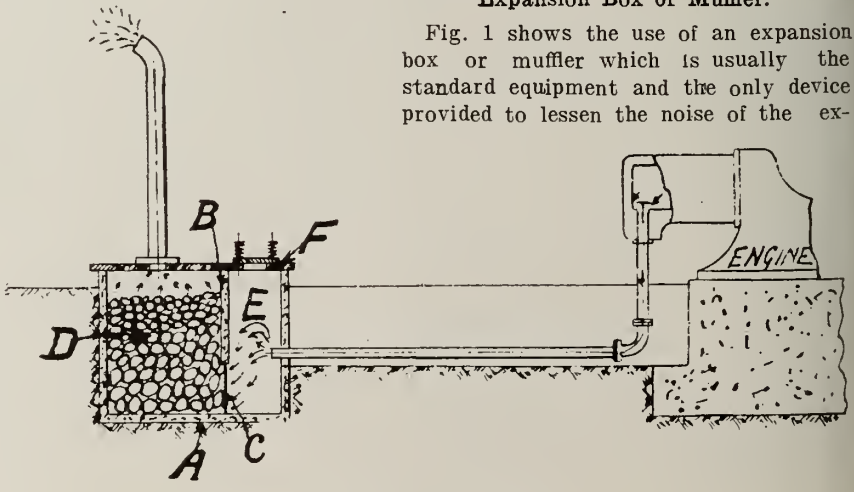


Fig. 3 — Expansion Box or Muffler.

haust on the majority of engines. Further quietening is obtained by the provision of one or two bonnets as shown at A and B on the same figure. If these bonnets are of sufficient size, suitable for passing the gas at low velocity without back pressure, this arrangement will answer all ordinary purposes.

Occasionally, however, still further quietening is necessary for engines in crowded residential neighborhoods, and the injection of a small spraying jet of water may be used in conjunction with the above. This method is of fullest value when the water is injected close under the exhaust valve as shown at Fig. 2. When using water injection, the exhaust pipe should have a gradual slope to the muffler and the muffler should be fitted with an open drain of sufficient area to carry all the water off freely.

Where more convenient for installation, and in the case of large power units, a more elaborate system may be used, and Fig. 3 shows such, which, if made of suitable capacity, will practically eliminate all exhaust noise. (A) represents a concrete pit with a division wall at (B); the bottom part (C) being arranged with iron bars embedded in the concrete in the form of a grating. This serves to keep the large stones in chamber (D) from falling through into the expansions chamber (E). The bottom part of the pit should have some form of drain, also some form of safety valve or explosion door, should be fitted in the cover (F) over the expansion chamber (E), as it must be remembered that if from any cause a charge is not ignited in the cylinder, it will by the engine operation be pumped out again into the exhaust pit in combustible proportions. There is then, every probability that the flame from the succeeding charge will ignite this combustible charge already in the pit and cause considerable pressure in chambers (E and D). However, all danger from this cause may be obviated if the simple provision shown in the sketch is made.

The temperature of the exhaust ranges from 600 to 1,000 degs. F., and the utilization of most of this waste heat presents no great difficulty. A good many commendable types of exhaust heaters are now on the market, any one of which, used in conjunction with the foregoing mentioned silencing arrangements, tends to further reduce the noise from the exhaust; at the same time generating from two to three pounds of steam at 60 pounds pressure per B.h.p. per hour when the load factor is around the region of 75 per cent.

By approaching his men in the right way, even the chief engineer occasionally picks up a valuable operating hint or improvement.

SAVERY'S ENGINE.

Ignoramus writes.—I remember reading a description some years ago of Savery's Atmospheric Engine, but have forgotten the principle on which it operated. If I am not mistaken, the engine in question was used for raising water from mines a good many years before James Watt came on the scene. The subject is, of course, merely one of historical interest now, but if you consider it suitable for the column's of The Power House, I should be greatly obliged to have you publish a sketch and description of the mechanism.

We gladly comply with our correspondent's request, as we believe the subject may not be too familiar to a large number of our readers. The sketch here shown is, of course, merely diagrammatic.

This engine was patented by Captain Thomas Savery in 1698, and was applied

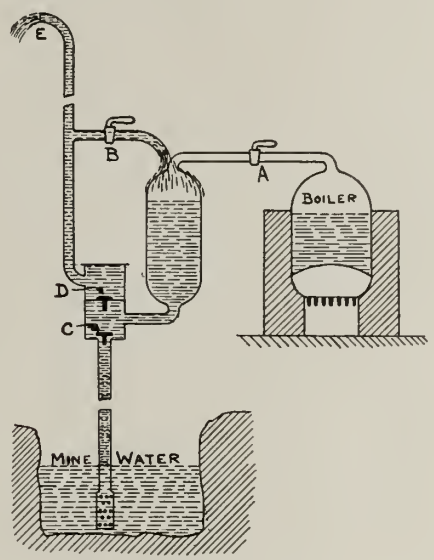


Diagram of Savery's Engine.

by him to the raising of water from mines in Cornwall and elsewhere. The action is as follows: Steam from the boiler is admitted to the receiver by means of the steam cock (A). As soon as the receiver is filled with steam, the cock (A) is closed, and the cock (B) opened, thus allowing a douche of cold water to play over the outside of the receiver, condensing the steam and producing a partial vacuum inside. The atmospheric pressure on the surface of the water now forces the latter up through the suction valve (C), nearly filling the receiver. The cock (B) is now closed, and the steam valve (A) again opened, so that the entering steam forces the water out of the receiver, through the delivery valve (D) and the discharge pipe (E).

As shown in the sketch, the action would be intermittent, but in the actual engine there was a duplex set of boilers, receivers and cocks; therefore, the filling of one receiver and the empyting of the other took place at the same time. It will be seen that the action is the same as that of the modern Pulsometer pump.

The degree of vacuum obtained in the receiver would not allow of the latter being placed more than 20 feet above the surface of the water, and the steam pressures then available (about 15 lbs.) would not allow of a discharge pipe higher than about 30 feet above the receiver; hence the limited lift available prevented the use of the device in many mines.

Savery used to say that if he could only get boilers and pipes of sufficient strength, he could force water to a height of 1,000 feet; as indeed he could have done, though in a very uneconomical way. The efficiency of a Savery engine was only about one-tenth of that of a modern pumping plant.—J.H.W.

COST OF RAISING STEAM.

By Chas. J. Mason.

OPERATING engineers are required to make certain calculations relating to the apparatus they control, and one such is that of finding the cost of evaporating 1,000 pounds of water into steam. It is a good thing to know how to do this in order to discover just what the plant in any given case is doing, and by comparing with other plants learn how its economy compares.

Of course, some of the readers of The Power House know how to proceed to work out the problem. To such there will be nothing new in this article; but possibly there may be some who do not know, and for their benefit I submit the following:—

Finding Fuel Cost of Evaporating 1,000 Pounds of Water Into Steam.

Let us assume in a given case that 21 tons of coal were consumed in a certain period of time; that the cost of the coal was $3.00 per ton of 2,000 pounds; that in the same time 398,616 pounds of water were evaporated into steam at a pressure of 100 lbs. per square inch absolute or 85.3 lbs. gauge pressure, and that the temperature of the feed water entering the boiler was 200 degs. F.

Now, the number of heat units in 1 pound of water at 200 degs. F. is 168.-713, as found from steam tables. In this connection, I might say that there are different steam tables in use, no two of which are precisely alike in values given. By using a different table from that employed in our example, slightly different results will be obtained, but which from a practical standpoint will not materially affect the commercial value of the problem.

The number of heat units in 1 pound of steam, at 100 lbs. pressure per square

inch absolute is 1181.866, and the number of heat units required to convert 1 pound of water into steam at atmospheric pressure (14.7 lbs. per square inch) is 966, in round numbers. This 966 value is the latent heat of steam at atmospheric pressure.

The method of applying the preceding data to our problem is as follows: We must first find what is termed "the factor of evaporation." This latter reduces the actual evaporation to the equivalent evaporation, from and at 212 degs. F., which in turn reduces the whole thing to an accepted standard of comparison. The factor of evaporation in this case is found by employing certain of the values before given. Thus:

$$\frac{1181.866 - 168.713}{966} = 1.048,$$

which simply means that for every pound of water actually evaporated under the stated conditions, 1.048 pounds of water would have been evaporated into steam at atmospheric pressure, from a feed water temperature of 212 degs. F; or, as briefly stated, from and at 212 degs. F.

The statement finally becomes:

21 tons × 300 cents × 1,000 lbs. water

398,616 lbs. water × 1.048 factor of evap. evap.

= 14.6 cents.

14.6 cents, therefore, is the cost of evaporating 1,000 pounds of water under the assumed conditions.

The foregoing is the fuel cost only. The total cost will exceed that; for labor, cost of motor, depreciation, taxes, insurance and interest on the investment of the plant as a whole, enter into the calculation in the last analysis.

I trust this may prove of interest to those who desire to learn something of commercial engineering problems, the need of which to operating engineers is becoming more apparent every day.

BELTING DATA.

By John Thorn.

INFORMATION on belting is a subject very seldom touched upon by writers for technical journals. In a small handbook printed for engineers by an American manufacturer there is some very valuable matter printed, and worth preserving by almost every engineer. As the book is not copyrighted, I am writing a few extracts, believing that they will be welcomed by many of your subscribers.

Horsepower of Belting.

A simple rule for ascertaining the transmission power of belting, without first computing the speed per minute at which it travels, is as follows:—Multiply diameter of pulley in inches by its revolutions per minute, and this product by width of the belt in inches. Divide this product by 3,300 for single belting, or by 2,100 for double belting, and the quotient will be the horsepower that can be safely transmitted.

To Measure Belts in the Roll.

Add to the diameter of the roll in inches the diameter of the hole in the centre. Multiply this sum by the number of coils and the product by 1.32. The three figures on the left represent number of feet in roll.

Punching and Lacing Belts.

In punching a belt for lacing, it is desirable to use an oval punch; the longer diameter being parallel with the belt, so as to cut off as little of the leather as possible. There should be in each end of the belt two rows of zig-zag holes, as small as possible, to do the work. In a 2-inch belt there should be three holes in each end; in a 2½-inch belt, four holes; in a 3-inch belt, five holes; in a 4-inch belt, seven holes; in a 5-inch belt, nine holes; in a 6-inch belt, eleven holes; in an 8-inch belt, fifteen holes; in a 10-inch belt, nineteen holes, and in a 12-inch belt, twenty-three holes.

No hole centre should come nearer to the side of the belt than ⅝ inch, and nearer the end than ⅞ inch. The second row should be at least 1¾ inches from the end. On wide belts these distances should be even a little greater.

Begin to lace in the centre of the belt; take much care to keep the ends exactly in line and to lace both sides with equal tightness. The lacing should not be crossed on the side of the belt that runs next to the pulley.

Miscellaneous.

To find width of belt when speed in feet per minute and horse power required are known.

Single Belts.—Divide the speed of belt by 800, then the horsepower wanted, if divided by this quotient, will give the width in inches of the belt required.

Double Belts.—Divide the speed of belt in feet per minute by 560, and proceed as in the case of single belts, for width in inches.

It is asserted that the grain side of the belt put next to the pulley will drive 30 per cent. more than the flesh side.

The speed of a belt being the same, size of pulley has small effect upon amount of power transmitted. Speed of shaft being the same, the advantage in favor of the larger pulleys over smaller pulleys is in proportion to their diameters.

To find length of belt; the distance between centres of shafts and size of pulleys being given.—add the diameters of the two pulleys together, divide the result by two and multiply the quotient by three and one-quarter. Add the product to twice the distance between the centres of the shafts, and you have the length substantially.

To find length of cross belt.—Square each, the diameter of the large pulley and distance between centres; add together and extract square root of sum; subtract from this, distance between centres; multiply remainder by 2, and add distance around outside of both pulleys. The result will be the length of cross belt.

INCREASING POWER PLANT CAPACITY.

By J. A. Seager.

THE flexibility of the steam turbo-generator set is being more fully realized in practice by the engineer in charge of power house operation. With the older type of steam prime mover, the limit of overload was not far removed from the most economical working load; the outcome being that either the unit had to be overpowered on the steam side so as to provide for excess loads, this resulting in running normally at reduced efficiency, or if high efficiency were desired, the unit would be incapable of taking heavy overloads except by such special means as by passing the steam direct into the low pressure cylinder or other similar method. Hence, as a rule with reciprocating steam prime movers, the limit of overload lay with the engine and not with the dynamo. When, however, the turbo-generator set came into vogue, it was found that the steam turbine was capable of taking particularly high overloads for long periods without much drop in efficiency, therefore, the limit of overload capacity was usually transferred to the electrical end of the combination; this limit being fixed either by commutating difficulties in the case of direct current machines, or by heating limits, particularly in machines of large size. The result of this new development is that means have been sought whereby the generator can be brought up to the same state of overload capacity flexibility as the turbine, and such methods, as an air blast to ventilate the rotor and stator windings very thoroughly, have now become common.

Ventilation of Turbo-Generator Sets.

The development of this idea by Mr. George H. Fawcus, manager of the Altrincham Electric Supply Co., Ltd., England, is shown in a recent patent, which stated generally, is the use of a refrigerating plant in conjunction with turbine sets to carry any turbine or

number of turbine sets over peak load with a good overload on each, thus increasing the capacity of the station without increasing the actual generating plant. Included in this scheme is an automatic method of control which will also be discussed.

The generator may have formed in its stator or rotor or in both of them channels for the passage of air as at present. The air first enters the refrigerator and is cooled to the desired extent, passing in this cool condition to the generator from which it emerges in a heated state. This heated air can be utilized, for example, by being supplied to the boiler furnaces to aid fuel combustion and may either be forced through the system by means of a fan or an induced draught may be adopted. Alternatively, water may be used instead of air; the heated water afterwards passing to the hot well of the power house.

An important point in connection with the arrangement is that if the water or air were continually passing in one direction from the generator ducts there would be a danger that some of the coils or other parts would get dangerously hot, while others would be kept cool, and in order to obtain equal cooling at all points, the direction of flow is automatically reversed from time to time. This in conjunction with the automatic control of the volume of supply of the cooling medium constitutes an effective means of keeping the temperature of the generator constant even under heavy loads.

Automatic Control.

Automatic control may be effected in at least two ways. For example, the inlet of the system, instead of being a plain orifice, may be conducted through a series of parallel pipes of comparatively small bore, each of which is under control of a valve operated electrically through the relay system. The feeble current end of the relay is then connected to points in the stem of a thermometer placed in the outlet of the system, and in accordance with the height of the mercury in the thermometer, one or more valves are opened. In this way, should the temperature of the outlet rise, an additional valve on the inlet is opened and a further supply of cooling medium through the system is obtained. Another method for obtaining the same result, is, with a circulating fan or pump installed, to use the thermometer to adjust the speed of the circulating fan or pump by means of methods which are well known. A refrigerator outfit can be common to all the generating sets in the station, or if required, each generating set may be supplied with its own unit. When air is used it is probably an advantage to humidify the cooling air in order to increase its heat absorbing effect.

It will be seen that such an apparatus would prove an important addition in a station where the plant is already fairly well loaded and it might even take the place of a generating set if the existing sets were sufficiently large on the steam side to take a good overload. The whole matter is of course a question of capital outlay and running cost, and although at the present moment, it is impossible to give definite figures obtained from actual service, it is apparent that there is quite enough in the idea to make the matter worth the careful attention of power house engineers.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

ROPE CAPACITY OF A DRUM.

THE rule used by the A. Leschen & Sons Rope Co. for computing the rope capacity of any sized drum is as follows:—Add the depth of flange in inches to the diameter of the drum, and multiply this result by the width (out to out) of the drum. This product is then multiplied by the figure below corresponding to the size of rope used:—

¼ in.	.....4.16	1⅜ in.	..... .138
⅜ in.	.....1.86	1½ in.	..... .116
7-16 in.	.....1.37	1⅝ in.	..... .099
½ in.	.....1.05	1¾ in.	..... .085
9-16 in.	..... .828	1⅞ in.	..... .074
⅝ in.	..... .672	2 in.	..... .066
¾ in.	..... .465	2⅛ in.	..... .058
⅞ in.	..... .342	2¼ in.	..... .052
1 in.	..... .262	2⅜ in.	..... .046
1⅛ in.	..... .207	2½ in.	..... .042
1¼ in.	..... .167		

Mr. E. F. Bradley has been appointed sales manager to the Canada Wire & Cable Co., Ltd. Mr. Bradley has been identified for some time with the Canadian General Electric Company.

Question Box

Hydraphane propounds the following question and asks for replies from fellow readers: If a pound of mercury at 160 degs. F. be mingled with a pound of mercury at 40 degs., what will be the resultant temperature? If the problem is reversed, and a pound of water at 160 deg. F. be mingled with a pound of mercury at 40 deg., what will be the resultant temperature—and why?

Answer.—If the specific heat of mercury were equal to that of water, the result would be the same in both cases; but the specific heat of water is 1, while that of mercury is .033.

The general rule for the mixture of two substances is as follows: Let M stand for the mass in pounds of the one substance; let S stand for the specific heat of the one substance; let m stand for the mass in pounds of the other substance; let s stand for the specific heat of the other substance.

Let T1 stand for the original temperature of substance M; let T2 stand for the original temperature of substance m; let T3 stand for the final temperature of the mixture.

Then, the loss of heat from the one substance = gain of heat by the other.

The loss of heat by the substance M = M S (T1 — T3), and the gain of heat by the substance m = ms (T3— T2).

Therefore, M S (T1 — T3) = m s (T3 — T2).

Applying this to "Hydraphane's" question, we get,

M = 1 lb.,
m = 1 lb.,
S = .033 (mercury),
s = 1 (water),
T1 = 160 degs. F.,
T2 = 40 degs. F.,
T3 = x (unknown).

Dealing with the first half of the problem, we have

$1 \times .033\ (160-x) = 1 \times 1\ (x - 40)$,
$5.28 - .033\ x = x - 40$,
$1.033\ x = 45.28$,
$x = 43.8$.

In the first case the resultant temperature will be 43.8, or say 44 degs. F.

In the second case it is the water that loses heat and the mercury that gains it, therefore, the values for the letters S and s must be changed around; S now being 1 and s being .033. Then

$1 \times 1\ (160 - x) = 1 \times .033\ (x - 40)$,
$160 - x = .033\ x - 1.32$,
$161.32 = 1.033\ x$,
$x = 156.16$.

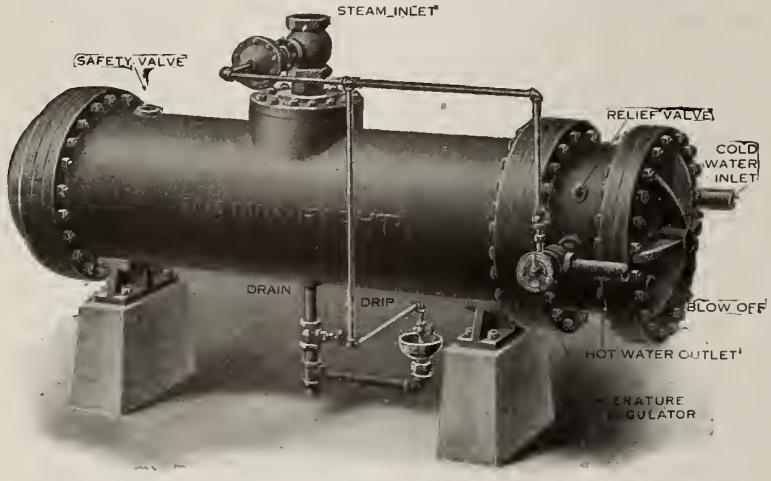
In the second case, the resultant temperature is say 156 degs. F.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

THE WAINWRIGHT DOMESTIC WATER HEATER.

THE Alberger Condennser Co. has recently developed a new type of domestic water heater which is designed particularly to fulfill the requirements



The Wainwright Spiralflow Water Heater.

of the hot water plant in which the service is intermittent and constant temperature of the water is desired. The water systems of hotels, hospitals, penal institutions and public baths are examples of typical installations of such plants. In such installations as the first three mentioned, almost invariably there are generating units for furnishing light and power. The hot water load in practically every case is but a small part of the total load, so that there is almost always sufficient exhaust steam for heating the water as it is drawn. In gymnasiums and public baths, the hot water load is practically the total load of the plant. Usually the heating is done by utilizing live steam direct from the boilers. For both types of installation, it is highly desirable to heat the water instantaneously as it is wanted, because, thereby, radiation losses are kept low.

The Wainwright domestic water heater is of the water tube instantaneous type. It is made of cast iron throughout with the exception of the heating surface; hence corrosion is minimized. The heating surface consists of Wainwright Spiralflow Tubing, which is a straight hard brass tube, expanded into one tube head and passing through a deep stuffing box of the condenser type in the other tube head. Upon the inner surface of the tube is a spiral coil which agitates the flow of the water through the tube, so as to secure for a given amount of heating surface a very high rate of heat transmission. The method of accommodating expansion and contraction makes this apparatus applicable for use on either high or low pressure steam and for either intermittent or constant service, without possibility of injurious strains being put upon any part of the equipment. Thus, long life of the latter is assured. For installations in which the storage of water is necessary, a storage tank is furnished in connection with the heater. When a constant temperature of the water is desired, an automatic temperature regulator of approved manufacture is supplied. The accompanying cut shows the Wainwright Spiralflow Heater as equipped with temperature regulator, for which we are indebted to the Alberger Condenser Co., New York, who are manufacturers of the heater.

CIRCULATION TEST OF ROBB-BRADY SCOTCH BOILER.

THE Robb-Brady Scotch Boiler is a modified form of the standard Scotch marine boiler, the changes from the standard form greatly increasing the circulation. The heating surfaces are arranged as in the standard form, there being the same internal furnace flues, but, in addition, there are two smaller

TEMPERATURE TEST

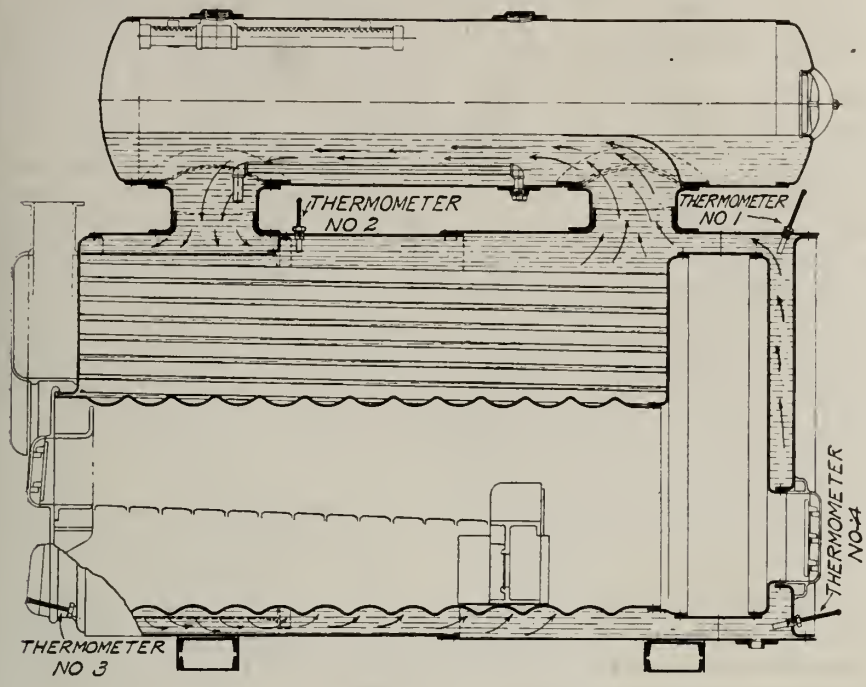
50 HP Robb Brady Scotch Boiler — March 31, 1912.

Framingham Sewerage Pumping Station, South Framingham, Mass.

Time P.M.	Thermometer No 1 On top of boiler at rear end.	Thermometer No. 2 On top of boiler at front end.	Thermometer No. 3 At bottom of boiler at front end.	Thermometer No. 4 At bottom of boiler at rear end.
3:40	114° F	112° F	80° F	82° F
3:45	126	124	80	82
3:50	138	140	80	83
3:55	150	150	81	84
4:00	170	170	82	86
4:05	194	190	84	87
4:10	210	210	98	90
4:15	226	224	210	136
4:20	231	230	226	180
4:25	244	242	234	230
4:30	258	260	252	248
4:35	276	278	268	270
4:40	292	292	292	290
4:45	310	308	306	310
4:50*	328	330	328	328
4:55	330	330	328	330
5:00	327	328	327	327

*Safety Valve Blowing Off.

shells, one above the other, in place of the large one. An annular circulating passage is also formed at the front end by the use of a plate beneath the front neck. This plate guides the cooler feed water around the shell and discharges it beneath the furnaces at the front. The water is heated while passing around the furnaces and among the tubes, and enters the steam drum by the rear neck.



Robb-Brady Scotch Boiler arranged for Circulation Test.

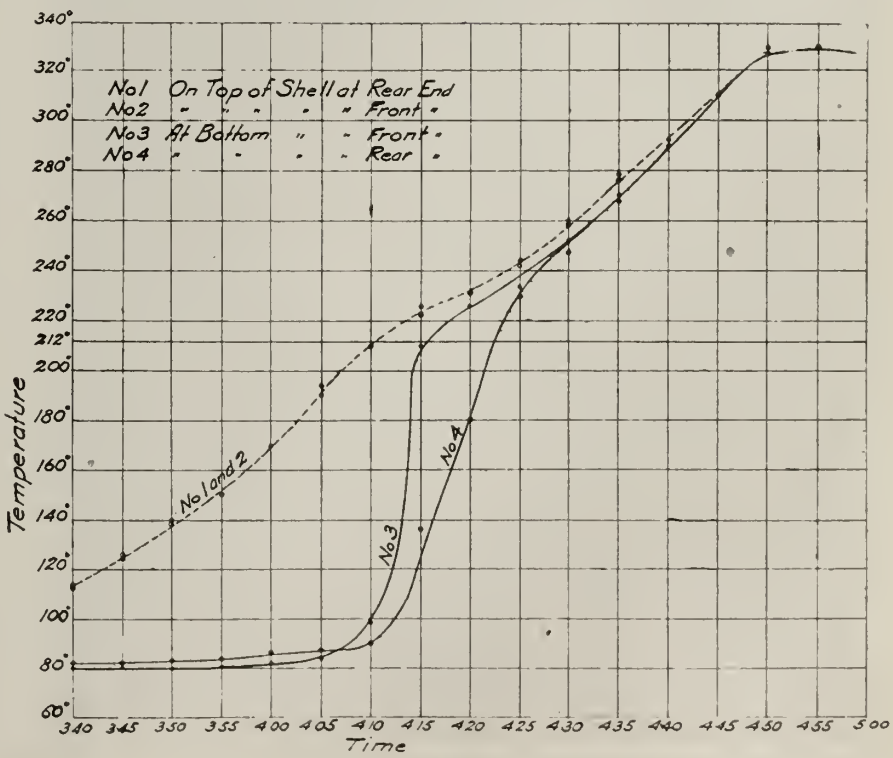
The claims for positive circulation, made by the builders, were thoroughly tested a short time ago at the Sewerage Pumping Station, Framingham, Mass. The Robb-Brady boiler at this plant was equipped with thermometer oil wells so that the temperature could be noted at four points as follows:—At the top of the shell near the front end; at the top of the shell at the rear just above the combustion chamber, at the front and rear, close to the bottom.

Test Details.

With water in the boiler at about 80 degrees, the fires were started and readings of all thermometers taken every five minutes. As was expected, the temperature of the water at the top of the shell increased steadily until the boiling point was reached. At the bottom, the temperature increased very slowly up to the time the upper thermometer indicated the boiling point. Then the bottom thermometers showed a sudden rise; jumping to within a few degrees of those at the top. From this time on, all four kept within a few degrees until 100 pounds pressure was reached, at which point practically no difference could be noted at the four points, showing conclusively that the circulation was positive and rapid.

How well the design fulfills the purpose is shown in the accompanying curve which gives graphically the thermometer readings at five minute intervals. The test proved that troubles due to poor circulation are a thing of the past and that positive circulation is easily obtained with the Robb-Brady device which forms an integral part of the boiler. The boiler is built under patents held by the Robb Engineering Company, Limited, of South Framingham, Mass., and Amherst, N.S., Canada.

The test was witnessed by many prominent consulting and operating engineers. A large delegation came from N.A.S.E. lodges Nos. 1, 12, 14 and 30 of Boston and Cambridge, Mass. Representatives of several boiler insurance companies were also present, among whom were:—Mr. T. G. Ranton, Chief Inspector of the Fidelity and Casualty Co., Boston; Mr. C. E. Goodwin, Chief Inspector of the Royal Indemnity Co., Boston; Chief Inspector Melcher, of the U.S. Guarantee and Casualty Co., Boston; and representatives of the Employers Liability Co.



Robb-Brady Scotch Boiler, Circulation Test.

FAIRBANKS SUSPENSION COAL SCALE.

UNTIL the installation of the Fairbanks Suspension Coal Scale, The Montreal Tramways & Power Co. had no means of keeping an accurate record of the amount of coal used at their power house. The coal was transferred from cars by the conveyor into the bunker and fed from there to the boilers. How much had been ordered was known, but no record after unloading was available.

There are ten-550 horse power Babcock & Wilcox boilers in this Power House, arranged in two rows, six on one side and four on the other; the coal bunker being located overhead between them. The scale hopper is mounted on a trolley which runs on a track in front of the boilers; the trolley being operated by means of a motor controlled from the floor below. In operation, the scale hopper is run-in under the overhead coal bunker, the hopper filled and the amount

of coal from the bunker weighed. The trolley is then run along the track until it is opposite the particular boiler which it is desired to feed and the contents of the scale hopper dumped into the feed hoppers of the automatic stokers. The scale is a one-ton Fairbanks Suspension Coal Scale with quick-weighing dial, below which rests the pad whereon is written a record of the weights.

This apparatus furnishes a check on coal consumption and boiler efficiency, and the scale can be easily adapted to meet the peculiar requirements of any power house. One of the greatest advantages resulting from its use is the ease with which coal can be transferred from any part of the overhead bunker to any particular boiler. By the old method, should one end of the bunker become empty, the boiler immediately underneath would be put out of commission, as there was absolutely no means of shifting the coal in the bunker. Should you have a poor grade of coal in one end of the bunker and a good grade in the other, with the Suspension Scale it would be an easy matter to use either grade for any boiler.

The Canadian Fairbanks-Morse Co., Limited, Montreal, with branches in all leading cities throughout the Dominion, are manufacturers of this equipment.

Fairbanks Suspension Coal Scale at the Power House of the Montreal Tramways & Power Co., Ltd.

NOVEL TYPE LOCOMOTIVE.

A novel type of locomotive is being developed under the patents of James Dunlop, of Glasgow. It is driven by compressed air, which is supplied by an oil engine-driven compressor. The compressed air is used on the closed circuit, sometimes called the dense-air system, in which a certain quantity of air passes continuously from the compressor to the engine or driving air motor, and then back to the compressor again. Leakage is automatically made up by a small auxiliary compressor. It is claimed that the closed-circuit system is more efficient than the open-circuit system, in which fresh air is continually being taken in by the compressor and the exhaust from the motor ejected to atmosphere.

In the closed-circuit system the average air pressure throughout the system is maintained at some definite figure, say 150 lbs., per square inch, the intake pressure at the motor being higher and the outlet lower. The range of pressure is governed by the control of the compressor and the cut-off of the motor. The compressor may be controlled by varying its speed, but more usually by altering the number of cylinders in action, this being done by lifting the air delivery valves off their seats in those cylinders to be put out of action. The air in the delivery main is then merely drawn in and pushed out through the open valve.

It is claimed that the fuel cost will be $2.11 per 1,000 effective horse-power hours with oil at $9.75 a ton, as against $3.75 for a steam locomotive with coal at $2.43. These costs are based on 0.5 lbs. of oil per B.h.p. at the engine, a recovery of 16 per cent. of the heat in the exhaust gases, and a mechanical efficiency for the locomotive of 90 per cent.

Fuel and Factory Economy*

By John A. Kerley, Cincinnati, O.

IN my estimation there is no subject that should receive more earnest consideration by the manufacture than that of fuel economy.

To those who have given much thought to this question it resolves itself into a very serious proposition, the importance of which is only fully appreciated by those having the keenest of foresight. Viewed from a mechanical operating standpoint, it is almost beyond understanding that we should in this supposedly enlightened age be going along dissipating fuel energy by converting into mechanical energy less than 18 per cent. of the former with our most modern triple-expansion and condensing engines, and as low as 5 per cent. in some of our ordinary single valve engines. The too common and erroneous idea that our country possesses an unlimited fuel supply does not, or should not, excuse such extravagance.

Of the progress made in the conversion of fuel energy into mechanical energy since Watt built his famous machine, we should be ashamed. I can attribute this to nothing but the selfishness of man to take what is at his disposal without due regard and thought for those who are to follow. Our forest depletion is a striking example of this, and is only an illustration of what may be expected in connection with our fuel supply unless some determined, continued and effective effort is put forth by all directly and indirectly concerned, looking to greater economy.

The latent heat necessary to convert water into gaseous steam represents 75

*Abstract of paper read at the annual meeting of the Middle States Ice Producers' Exchange, April, 1912.

$100.00 in Cash Prizes

WE will give One Hundred Dollars in cash to the Engineer who shows by cards taken on an American Thompson Improved Indicator the greatest ***percentage*** of saving made during all or any part of the time between June 1st and October 1st, 1912.

All statements of economies effected by the use of the Indicator diagrams must be certified by the Superintendent, Manager or Owner of the Steam Plant operated by the Engineer.

Readings and deductions must be made by the Engineer himself.

Prizes to be awarded by a committee consisting of three unprejudiced experts whose names will be published when the award is announced.

In case of a tie, prizes will be equally divided among the tying contestants.

We retain the privilege of publishing the reports of any or all competitors; agreeing, however, not to publish the name of Plant, Engineer or Employer without special permission.

First prize, $50.00; second prize, $25.00; next five, $5.00 each.

If by chance a prize is awarded by the Committee to an Engineer who is buying his Indicator on our special installment plan (a thing no member of the Committee will know), in addition to the cash award we will make that Engineer a present of the balance of his account even if he has only made his first payment.

Remember the awards are for ***Percentage*** of Saving not volume of dollars.

This gives every man a chance.

Cards and papers must be submitted on or before October 31, 1912. Awards will be made December 1, 1912.

Address all papers to.

The American Steam Gauge & Valve Mfg. Co.

208 Camden Street - - Boston, Mass.

per cent. of the fuel energy. For this we get no return in the average plant, but provide steam condensers of large proportions and large volumes of water to absorb and convey away to the sewer or elsewhere this great energy waste.

The countless numbers of exhaust pipes that are to be seen all over the manufacturing world, belching forth into the atmosphere, to the discomfort and annoyance of those in the immediate vicinity, volumes of low-tension steam, are some of the glaring evidences of our wastefulness. The time is fast approaching when fuels will be purchased upon the B.t.u. basis exclusively; this being the only correct basis upon which to trade. Many of the large consumers are now working under this arrangement, and they have been surprised at the results obtained, and surprised at some of the facts brought out concerning certain fuels which analysis has shown up.

Design and Construction of Furnaces.

A disregard and ignorance of the laws of combustion by the average furnace builder has resulted in the construction of furnaces that have nothing in particular to recommend them but their probable low first cost. It is impossible, almost ridiculous, to suppose that there can be any degree of economy when attempting to burn all kinds of fuel in or with the same kind of furnace. With an article so varying in its composition as coal, running as low in volatile as 17 per cent. and as high in carbon as 78 per cent., and as low in refuse as 5 per cent. to that as high in volatile as 30 per cent. and low in carbon as 45 per cent. and as high in refuse as 25 per cent., it should be clear to those who have given any thought to the theory of combustion that special designs to meet the different requirements are imperative to get anything like the efficiency that is possible, and in the nature of things should be insisted upon.

Fuel Considerations.

The most economical coal to purchase in the different localities is not given the intelligent thought and consideration that its importance should demand. A ton of coal is such an indefinite quantity that any attempt at calculating its worth without an analysis is folly; still, this is about the only standard of value —its cost per ton that is recognized by a large number of purchasing agents and manufacturers to-day. To arrive at an intelligent conclusion of the value of any fuel for any specific service its heat value in British thermal units must be known; the conditions for dissipating and absorbing this energy must be recognized; the cost of shipment must be considered, and the deterioration of furnaces and labor necessary for its handling must be calculated.

The value of natural gas and crude oil for fuel is subject to the same thought and consideration in the different localities, and resolves itself into the same problem of British thermal units value, coupled with its cost of application, reliability, etc., in comparison with coal or other available fuels.

Comparisons and Conditions.

The drawing of comparisons of results obtained by different plants in different localities, with a view of determining the most efficient and desirable outfit is a most difficult proposition to execute with any degree of accuracy, unless all the conditions are known and studied. A plant may be situated where the fuel haulage adds quite largely to fuel cost. Again, a stoker equipment designed for cheap fuel may or may not prove a paying proposition.

Interest on investment, cost of maintenance and cost on additional fuel haulage must be considered, for it must be borne in mind it costs as much to get a ton of 6,000 B.t.u. value coal from the mine to the boiler room as it does one of 14,000 B.t.u. Again, the many automatic stoking devices that have been placed upon the market of late, designed to handle this cheap nut and slack, have resulted in many cases on placing a fictitious value upon this class of fuel. This, coupled with cost of hauling 133 per cent. more fuel to get the same heat value, with its natural increased ratio of ash production, must be carefully considered, and each individual condition must be carefully studied from its many viewpoints before an intelligent conclusion can be arrived at.

Economic Improvements Effected.

It is some satisfaction to note the especial effort and determination that has been exercised in the past year or two to do something to bring more economical results. Those, who have kept posted in the engine-room, designing and conery as a prime mover, realize the fact that most of this effort has been exerted in the engine-room designing and constructing for the higher steam pressures and velocities engines with quick opening and large ported valves, permitting of full boiler pressure on the piston to a point determined by the automatic governor, and giving the benefits to be derived by steam expansion as well as condensers that are tight and of ample capacity to secure a high degree of vacuum. These are some of the economic improvements that have been effected.

Effort in the Boiler Room.

There being, seemingly, no further economies possible on the reciprocating engine, other parts of the power plant have recently been critically explored, and we now find the mechanical mind pretty generally concentrated on the steam generating or boiler room and with encouraging results. That furnace design and boiler installation has been one of guesswork to a marked extent is evidenced by the many and varied plans of construction that have been executed; perfection being in each case claimed by their designers and builders.

It is of very recent date that a device has been placed on the market that makes possible a correct checking up of the results attained. With this apparatus there is no more guess-work as to what is taking place in the furnace. It gives a correct reading of the percentage of CO_2, resulting from combustion as well as showing up any deficiencies or irregularities that exist in the nature of same. With the calorimeter giving us the available energy, contained in the fuel and the flue gas apparatus giving us a correct statement as to what we are getting out of it, there is no reason or excuse why we cannot design our furnances and install our boilers in a way to produce the highest results.

Coming Prime Movers.

The development of the steam turbine, with its high initial steam pressure and low exhaust pressure, showing a temperature as low as 78 degrees F., is rapidly supplanting the reciprocating engine, especially in the larger units. In addition to its higher efficiency, its even balance, smooth running, freedom from shocks and jars, it requires less foundation as well as space for a given horsepower; and this latter item, alone, in towns and cities where these large plants are usually found, is of considerable consequence and importance. The development of the internal-combustion engine, as well as the gas producer, should also receive much thought and consideration.

I cannot but feel that the days of the old, tried and trusted reciprocating engine are numbered; its extravagance demands it, and it is unquestionably a reflection upon our inventive genius that this has not been done years ago.

MOVING PICTURES TO TEACH RAILROAD MEN.

Moving pictures are to be used by the Central Georgia Railroad to teach the elements of railroading to the more ignorant of the employes, many of whom are illiterate. It is believed that by substituting pictures for textbooks they can be taught to perform their duties more intelligently. Almost every detail of train operation can be shown effectively on the screen, and the pictures can be run over as many times as may be needed to teach the processes thoroughly.

Clean Boilers Save Fuel
and
Prevent Accidents

The Spring time is here, and you should carefully examine your power plant, and put it in good condition for the season's business. It is also a good time to put a

Liberty Tube Cleaner

to work, and have your boilers brought up to their normal capacity. If you will advise us the number and types of your boilers, also whether you want to use water, air or steam in operating the machine, we will be prepared to tell you the type of cleaner best adapted to your work.

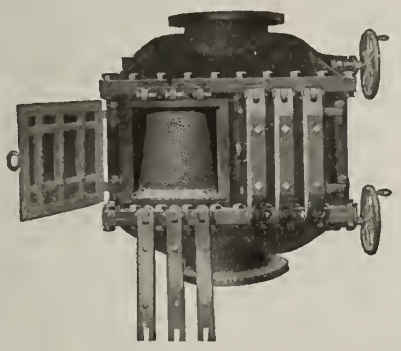
Remember! There are no other cleaners on the market equal to the Liberty, or capable of doing the same amount of work in as short a time, or at such low cost for up-keep.

Cyclone for Air or Steam.

Liberty Manufacturing Company

6904 Susquehanna Street, Pittsburgh, Penn.

CANADIAN REPRESENTATIVES:
Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto, Winnipeg.



The Best Apparatus
to
Clean Water

The adopted standard for straining all liquids is the Twin Strainer. Its satisfactory performance in removing all kinds of solid substances from liquids has made it the universal strainer. It is universal, due to its design.

The Twin Strainer

will work equally well in any position—horizontal, vertical or at an angle. The water or liquid to be strained can flow in any direction. It can be easily be cleaned in a few minutes, and while you are cleaning one side the other strains the trash out of the water. The flow is continous and uninterrupted.

The valves are vacuum tight, making the Twin Srainer especially desirable for suction or condenser work. The higher the pressure, the tighter the valves. Wedges are provided, which automatically take up any wear and firmly seat the valves, thereby preventing leaks.

The Twin Strainer will reduce the cost of plant operation, save labor and increase the efficiency of all water handling or consuming equipment.

ELLIOTT COMPANY,

6902 Susquehanna Street, Pittsburgh, Penn.

CANADIAN REPRESENTATIVES:
Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Toronto, Winnipeg.

The advertiser would like to know where you saw his advertisement—tell him.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

Vernon, B.C.—Tenders in duplicate, for electrical equipment will be received by D. G. Tate, City Clerk, until June 10th, 1912, for the delivery f.o.b. Vernon, B.C., of the following:—

1 125 K.W., three phase, sixty cycle generator.
1 Exciter, direct connected to above.
1 Five panel switchboard.
1 Series Tungsten or
1 Arc lighting system.

Powell River.—The Power River Co., Ltd., is building a 5-ton ice making and refrigerating plant, machinery being furnished by the Armstrong Machinery Co., Spokane, Wash.

Prince Rupert.—It is reported that the Seal Cove Fishing Co. has decided to establish a fish freezing and cold storage plant and cannery, at a total cost of about $300,000, on the shore of Tuck's inlet, across from Prince Rupert.

Chilliwack.—The Chilliwack Creamery Association will equip its creamery with a 24-ton refrigerating plant, contract for machinery having been let to the Frick Co., Waynesboro, Pa.

Grand Forks.—Jeff Davis & Co., merchants, have contracted with the Armstrong Machinery Co., Spokane, Wash., for the installation of a 2-ton Siberian refrigeratiug machine, which is now being installed.

SASKATCHEWAN.

Regina.—The equipment at the power house will be materially increased during the ensuing year. Provision has been made for the purchase of a street railway unit similar to the one already in use. Although extensions were made to the lighting plant during the early part of the present year, it will be necessary to purchase still another large lighting unit. It will be installed early in 1913.

Saskatoon.—As a result of the investigation of the conditions and possibilities of developing power on the South Saskatchewan, below the city of Saskatoon, H. M. E. Evans, head of the Saskatoon Power Company, has reported to the city council that 14,000 horsepower could be generated at a total construction cost of $2,200,000. The cost includes the electrical equipment for delivery of power to the city limits. The estimate was made by a party of engineers from Stone & Webster, Boston, Mass. The original estimate of Canadian engineers was 4,000 horse-power, at a cost of $866,000. On the basis of those figures an agreement was entered into by the city with the company to buy the entire output at $33 per horse-power, delivered.

Saskatoon.—Tenders will be received by the City Commissioners up to noon of Tuesday, June 25th, 1912, for the complete installation (including all buildings) of a 70 ton per 24 hours incinerator plant, and the operation of the same for a period of three months after completion.

Moose Jaw.—The contract for laying about 96,000 lineal feet of 18-inch steel water pipe has been awarded one-half to Maurice S. Holmes, Souris, Man., at 90c per lineal foot complete, and the other half to the Moose Jaw Construction Company, Ltd., at 94c per lineal foot complete.

Moose Jaw.—The Moose Jaw Construction Company, Limited, have received the contract for supplying and erecting a reinforced concrete reservoir of 2,000,000 gallons capacity at a cost of $34,352.

Moose Jaw.—The contract for supplying and erecting four centrifugal pumps, two motors, wiring, switchboard and accessories, has been awarded to The Canadian Boving Co., Ltd., 164 Bay Street, Toronto. Price, $4,075.

Moose Jaw.—Contracts for supplying and erecting two prime mover equipments, transmission equipment and accessories for headworks pumping station at Caron, have been awarded to the Canadian Fairbanks-Morse Co., Ltd., Montreal, their price beiug $8,755.

Moose Jaw.—Supply of various valves and fittiugs for waterworks installation:—Contractors, Messrs. Drummond, McCall & Co., Montreal. Total price value, about $8,000.

Moose Jaw.—The contract for supplying aud erecting one elevated water tank of 75,000 gallons capacity, has been awarded to George T. Horton, Washington Heights Station, Chicago, Ill., at the price of $6,400.

Prince Albert.—The council recently approved an agreement between the city and the Ambursen Hydraulic Construction Co. of Montreal under which actual constructiou will begin in a few weeks on the Lacolle Falls power scheme, in the carrying out of which, Prince Albert will obtain 4,000 horse-power from the initial development. The contract which the company has undertaken involves the construction of a dam, head gates and lock. The total cost of the works is estimated at $578,000.

MANITOBA.

Winnipeg.—Matthews, Lang & Co., Winnipeg, Canada, have secured ground in the stockyards district, where they propose to build a modern abattoir aud meat packing plant. A cold storage warehouse will also be erected by them in the business district.

Winnipeg.—It is reported that the sum of $500,000 has been appropriated by the city of Winnipeg, Man., for the construction of a municipal abattoir.

ONTARIO.

Northern Ontario.—Five more towns in the northern part of the province will be served by the Hydro-Electric Power Commission—Barrie, Stayner, Collingwood, Coldwater and Elmvale. Preliminary estimates have been submitted by the commission to the town of Barrie for a supply of power under contract between the commission and the Simcoe Railway & Power Co., developing at the Big Chute Falls on the Severn River. An extension of the lines built by the commission supplying Midland and Penetang will be made to the five new municipalities in the Hydro-Electric belt. Final estimates will be submitted to these towns in the near future.

Kenora.—The Corporation of Kenora has awarded to Allis-Chalmers-Bullock, Ltd., of Montreal, the contract for another hydro-electric unit. It will consist of two twin horizontal turbines in open flume, connected to form a quadruplex turbine of 900 h.p. at 150 r.p.m. under a head of 17 to 33 feet; an alternator of 625 kw. 3 phase, 60 cycle, 2400 volts, and a self contained oil pressure governor. This will make the fourth water wheel type alternator of the same capacity built by the company for Kenora.

Ingersoll.—Municipal ownership of the waterworks system went into effect recently, but was not marked by auything of a ceremonious nature. A few hours before the transfer was to take place, the large main burst, but fortunately the result was not serious. By steady work throughout the night the regular service was restored early next morning.

Hamilton.—A company has been organized by local business men under the name Alert Amateur Athletic Association, to establish an artificial ice skating rink and an arena large enough to accommodate 5,000 people. Contract for a 50-ton raw water ice making plant, with flooded freezing system and direct expansion piping for skating surface and for ice making, was let to the Frick Co., Waynesboro, Pa., U.S.A.

Ottawa.—The legislature has approved the order granting the city power to borrow

CLASSIFIED ADVERTISING

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ELECTRICAL ENGINEER, NOW IN CHARGE of operating department of large power company, wants change. Experience with 10,000 v., 3-phase, 50-cycle overhead and underground mains and sub-stations. Box No. 115, The Power House, Toronto.

SALESMAN'S POSITION, EXPERIENCE IN Canada and England. Steady and reliable, age 34, engineering or electrical specialty preferred. Highest recommendation. Address, J. Snowball, 1023 Second Avenue E., Owen Sound, Ont.

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BELTING FOR SALE—800,000 FEET OF best quality leather, rubber, hair and canvas belting, bought from bankrupt manufacturers at 25% to 75% less than the regular value. Also a large quantity of slightly used belting, piping, chains, rails, pulleys, hangers, cotton waste, etc., at very low prices. Send for catalogue. Imperial Belting and Supply Co., 5 Queen Street, Montreal.

GAS ENGINE FOR SALE—80 H.P. KYNOCH Gas Engine in good order and giving satisfaction. To be sold at good terms for an early buyer. Might also be exchanged for a Corliss Steam Engine of 80 H.P. with 2' return tubular boilers. The engine might be connected with direct generator of same h.p. J. B. & A. Gaulin, St. Francois, P. Q.

FOR SALE—IDEAL PACKLESS VALVE CO. desire to dispose of their entire business, which is composed of over $9,000.00 worth of valve making machinery, tools and Patterns, also Letters Patent, for a high-grade, simple and durable Packless Valve. Can prove to anyone interested, the value of patent, also that the construction is the most perfect of anything yet on the market, can give references to many well-known people who are now using our valve. Will send printed list of inventory upon application. IDEAL PACKLESS VALVE CO., Walkerville, Ont.

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LAKE ERIE BOILER COMPOUND CO. REquire a few first-class representatives to sell their well-known compound. Liberal commission paid to live men, and exclusive territory. Write at once, giving references, 11 Colborne St., Toronto. (tf)

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BOOKLETS, CATALOGUES, PRICE LISTS, Handbills and any other fine printing at fiercely competitive prices. Russell Smart Advertising Agency, 40v, Chancery Lane, London, England. (7)

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MODERN FIREPROOF CONSTRUCTION—Our system of reinforced concrete work—as successfully used in many of Canada's largest buildings—gives better results at lower cost. "A strong statement," you will say. Write us and let us prove our claims. That's fair. Leach Concrete Co., Limited, 100 King St. West, Toronto (tf)

WANTED

WANTED—EVERY POWER HOUSE IN Canada to remember that C. E. Shedrick, Craig Street West, Montreal, is still repairing measuring instruments, both switchboard and portable. Twenty-five years' experience in repairing all kinds and makes on the market. Intregating meters repaired, tested and sealed, and returned on quick time.

$58,000, of which $2,400 is to be for purchasing a refrigerating plant to be installed in the City Hospital.

QUEBEC.

Murray Bay.—A report has been received from Murray Bay that operation of the new power house of the Eastern Canada Power & Pulp Co. has commenced, and that everything is working satisfactorily.

Montreal.—Through Mr. R. S. Kelsch, consulting engineer, the Sayer Electrical Co., Montreal, have been awarded the contract for the electrical work of the Windsor Hotel power plant.

Quebec.—The management of the Dorchester Electric Company has purchased a large lot of land known as the Taschereau property. It is said that the company intends immediately erecting their workshops on the site.

NOVA SCOTIA.

Shelburne.—The Roseway Fish Co. has been organized and incorporated with $20,000 capital by Amos Pentz, J. R. Bower, Capt. John Hipson and others. The company will establish a cold storage warehouse and fish handling plant.

Power Equipment for Sale

2—Tandem Compound Wheelock Engines, cylinders 21" and 38" x 46" stroke.
2—Fly-wheels 18' diameter, 46" face.
2—Double leather belts, each 112' long, 42" wide.
2—Tubular water heaters.
2—Northey jet condensers, cylinders 12" and 18" x 18" stroke.
1—6" line shaft, 15' long, with friction coupling and pulley 4' 11" x 46".
6—Fire tube boilers, each 63" diameter, 14' long, containing 84 three-inch tubes. Pressure allowed by Boiler Insurance Co., 110 lbs. per sq. inch.
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All the above steam and water connections in very good order. These engines were started in 1894, but were seldom used, being an Auxiliary Plant. Offers will be received for all or any of this plant by

THE OTTAWA ELECTRIC COMPANY, 35 Sparks Street, OTTAWA, ONT.

Canada's New Industry.

Announcement

of the

Standard Underground Cable Co., of Canada, Ltd.

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Standard Products

Copper Rods
Bare Wire and Cable
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Magnet Wire
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Cable Systems Installed Complete
Terminals and Junction Boxes
Splicing Tubes and Compounds
Excelcite Strips
Insulating Tapes and Varnishes
Cable Hangers and Supports

This company, although a separate concern, will maintain in every respect the reputation for the high quality of its goods established by its Associate American Company in its 30 years of successful manufacturing experience. You will find Standard Products in some of the largest electrical installations in the Dominion. Ask a user! *Get Standard prices before you buy!*

Standard Underground Cable Co., of Canada, Limited

Dept. B. **Hamilton, Ont.**

Power Transmission Equipment and Machinery

MECHANICAL MATERIAL CONVEYORS, INDUSTRIAL RAILWAYS.
Including Rails, Switches, Frogs, Cars, etc.,

—FOR—

MILLS, FACTORIES, MINES, GRAIN ELEVATORS

We carry in Stock a complete line of Transmission Equipment as below.

Iron Pulleys, Solid and Split
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Belt Tighteners,
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Sprocket Chain Attachments,
Car Movers and Pullers,
Iron Work for Dumps,
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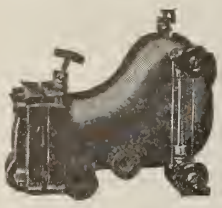
Equipment and Supplies for 50 Grain Elevators carried in stock at all times.
SEND US YOUR SPECIFICATIONS.

THE MANITOBA BRIDGE AND IRON WORKS, LIMITED
WINNIPEG, MAN.



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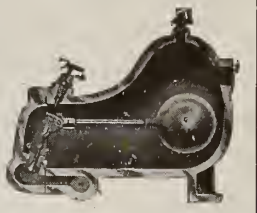
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



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Mueller Pressure Reducing and Regulating Valves

Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

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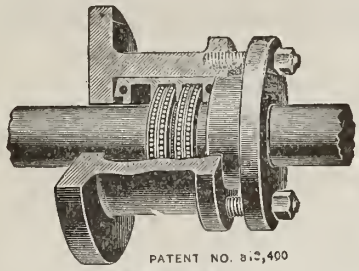

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Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

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A Unit saved from the exhaust is worth two in the coal pile.

WAINWRIGHT WATER HEATERS
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Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

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The only union made absolutely Non-Corrosive. Brass to iron in all contact points. Ball joint; Octagon ends, any wrench can be used. Adapted for heavy service. Every union air tested at factory. Send for circular B, describing the above and other fittings made by

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We are the largest firm in Canada making a specialty of the production of **Sanitary Cotton Wiping Cloths** by a new up-to-date process.

We are supplying the largest manufacturing plants, power houses and machine shops throughout the Dominion.

WASTE

We also are manufacturers and large importers of cotton and wool waste. We can quote the very best prices.

Prices and samples of both waste and wipers sent free on request.

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Engineers, Machinists and Draughtsmen

Will find a full and select line of Drawing Instruments and Supplies at the leading house in Canada

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"PHILADELPHIA" GREASE CUP

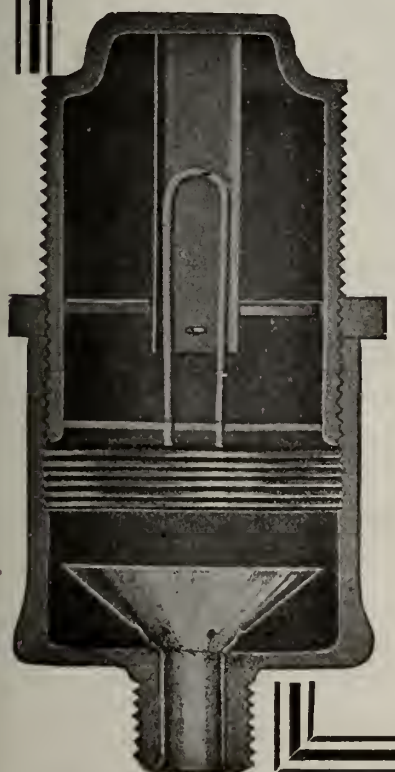
SAVING GUARANTEED

GREASE

Is Better and More Uniform Lubrication and Cheaper Than Oil

when it is properly made and used in our "PHILADELPHIA" Compressed Air Grease Cup, because there is absolutely no waste to contend with and the Grease is under perfect control until the last drop is used.

Oil used on machinery cannot be controlled, resulting in a constant dripping that means a loss of money to the user.



Why permit this loss to continue when at very little cost you can secure a perfect lubricator that will save time, money and labor—a lubricator that requires no attention after it is once filled.

The "PHILADELPHIA" efficiency cannot be affected by centrifugal force when used on loose pulleys.

Give the "PHILADELPHIA" a trial—we guarantee it to save 50% over any other lubricating system.

Write for price list and circulars.

Peterborough Lubricator Mfg. Co., Limited

PETERBOROUGH, ONTARIO

Your Belting will cost you less per day of service

if you specify

"CLIMAX"

or

"AMPHIBIA"

(WATERPROOF)

Leather Belting

This "per-day-of-service" basis is the **only** way to figure belting costs. If one belt costs more **at first** but lasts **longer,** it is the cheapest belt.

Our belts last longer.

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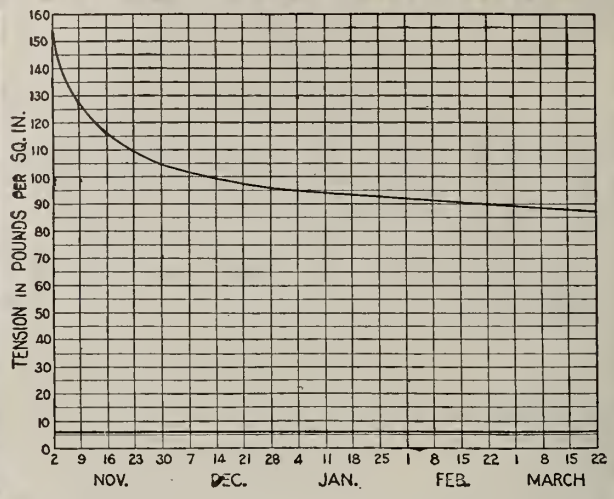
For over 35 years the makers of the best leather belts



Tight Belts and why ultimate economy demands slack belts treated with Cling-Surface.

The upper curve (Trans. A.S.M.E. Vol. 31, page 43), indicates fall in tension in a leather belt 5-3/8 in. wide by 15/32 in. thick, while driving a large rotary planer, and depending upon initial tension to prevent slip. That tightening to prevent slip is dead wrong, is well proven by the conditions represented here. Frequent readjustment of the tension here would be necessary, would involve considerable labor expense and would certainly lead to rapid destruction of the belt.

There would be no variation in initial tension if this belt were treated with Cling-Surface for the simple reason that there need be no initial tension other than the weight of the belt. Assuming a distance of 20 feet between pulley centres and a 5 in. sag (which is small on such a belt filled with Cling-Surface) and figuring for the same belt as used above, there would be but **6 lb. initial tension per sq. in. of belt section,** as plotted plainly on this diagram.

On the average belt treated with Cling-Surface, the idle half, if it's on top, can be run so slack that it will almost touch the working half, and this slackness increases contact areas on both driving and driven pulleys. A 40 per cent. increase of contact area is not uncommon and this with the interior flexibility and surface softness imparted by the Cling-Surface gives the belt a maximum gripping power and transmission efficiency.

A Cling-Surface treated belt does the useful work at best economy because the bearings need not be loaded with useless tension, and this invariably means a saving of lubricants, decreased attention, less danger of broken pulleys, hot boxes, strained shafting and broken belts, and a power economy that for the entire system reaches an astonishing figure. Besides this, Cling-Surface keeps the belt in perfect condition inside and out, —mellow, soft but not weak, waterproofed and preserved,

A trial order and a fair test will prove to your entire satisfaction that Cling-Surface is a real money saver on any leather—canvas, camel's hair, rubber or balata belting, regardless of the duty. If it doesn't, we do not want one penny for the Cling-Surface used, and the rest may be returned. Ask for literature:

Cling-Surface Co

1057 Niagara Street Buffalo N Y

42

"STICK TO THE SOLID STICK"

We'll Send You a Half-Pound Free

This is OUR way of proving to you the advantages of STEPHENSON BAR BELT DRESSING over liquid or semi-liquid dressing. The price of the stamp you use in writing us entitles you to make an important test in your own plant, at our expense. STEPHENSON BAR BELT DRESSING takes effect instantly, as soon as it touches the belt. No waste, spattering, muss—nor any other troubles. "STICK TO THE SOLID STICK" and you can show a saving in oils, greases and belt expense. Write for the free half-pound sample TO-DAY.

WHAT ENGINEERS THINK OF THESE HALF-POUND SAMPLES

"It is the first bar belt dressing I have used that makes the belts work properly."

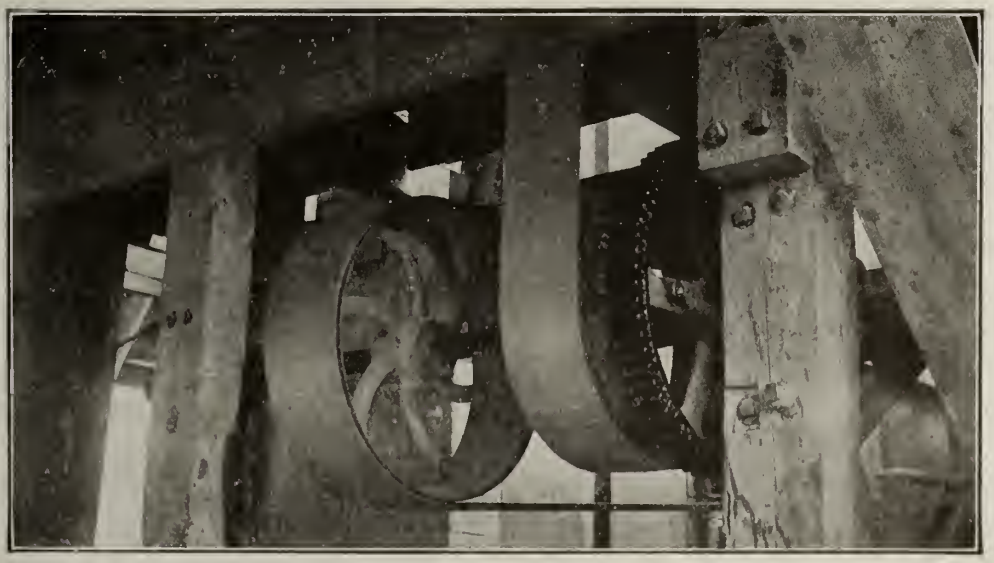
"I found your dressing all O. K. I have asked my company to buy me a 12-lb. box."

"I received your sample of belt dressing and wish to say I think it is all you claim for it. After using a small quantity of your dressing for a couple of weeks we can now use our belts slack, without any trouble from slipping.

NONE GENUINE WITHOUT TRADE MARK

Stephenson Manufacturing Company

Established 1888 **Albany, N. Y.** Incorporated 1897



The accompanying illustration shows a photograph of SCANDINAVIA BELTING which has been used in a contractor's plant for something over two years. These belts have been exposed to a great deal of dust, and all kinds of weather and atmospheric conditions, including the heat of summer and the cold in winter, and wet.

These belts have been giving good service and are still in good condition.

It will pay you to investigate SCANDINAVIA BELTING. We do not claim that this is good for universal use, but for a great many drives, we do claim that it is superior to any other belt, and we can at the same time save you money on both your initial cost, and your cost of maintenance.

Ask us for our new bulletin "The Main Drive."

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Harris Heavy Pressure

THE BABBITT METAL WITHOUT A FAULT

It is doubly copper hardened,
It is guaranteed not to crack or squeeze out.
It positively eliminates friction.
It runs cool at any speed.

Harris Heavy Pressure is the Engineer's Trusty Friend

OUR GUARANTEE IS BACK OF EVERY POUND

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Forbes Motor Driven PIPE CUTTING AND THREADING MACHINE

has all the advantages of the belt driven type, with compactness, power-saving and unusual operating convenience in addition. The motor is concealed inside the base of machine, the various speed changes are under lever control: no friction losses, no wasted power.

The absence of countershafts permits heavy lengths of pipe to be handled with cranes or overhead trolleys, or the machine can be taken to the work.

Full description on request. Write us.

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Dixon's Flake Graphite No. 1.
This is the standard size of Dixon's Ticonderoga Flake Graphite, and is recommended for general lubricating requirements.

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A more finely ground graphite than No. 1, though of the same stock. This is adapted to close-fitting bearings and delicate mechanism.

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This is a selected grade of Dixon's Ticonderoga Flake Graphite ground even finer than the No. 2 Flake. It is widely used in stationary gas engines. This grade of graphite is also used on type-setting machinery.

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A strongly adhesive grease of heavy body; cannot be washed off by fresh, salt, alkaline, or acid water. Especially adapted for wire rope, gears, slides, chains, elevatorways, mining and quarrying machinery, and generally on machinery exposed to water or the weather.

"Graphite As A Lubricant," and Sample 222C free.

JOSEPH DIXON CRUCIBLE CO.
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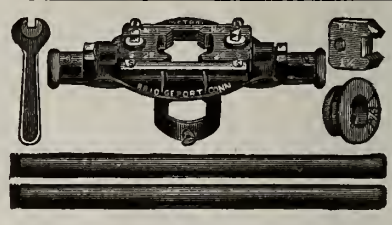
METAL POLISH
USED AND ENDORSED BY THE LEADING DEALERS
SOLD ALL OVER THE WORLD



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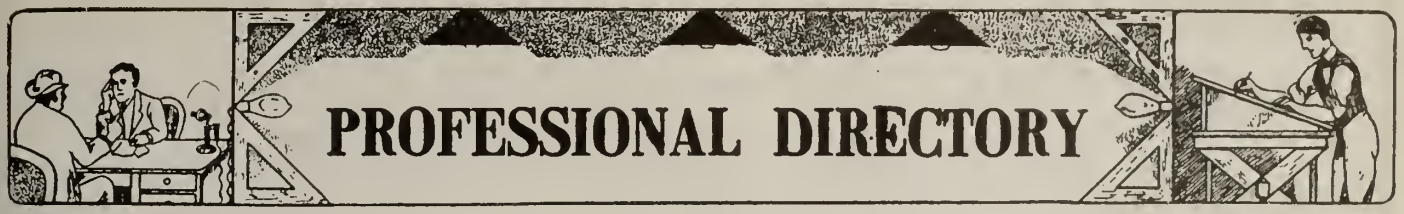

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WATER POWER EQUIPMENT ONLY
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WATER GAUGE GLASSES?
They never corrode. They last longer.
They defy competition.
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TEAR THIS OUT NOW.
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The Devoe Electric Switch Co.
157 Craig West, - MONTREAL

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BABCOCK & WILCOX, Limited

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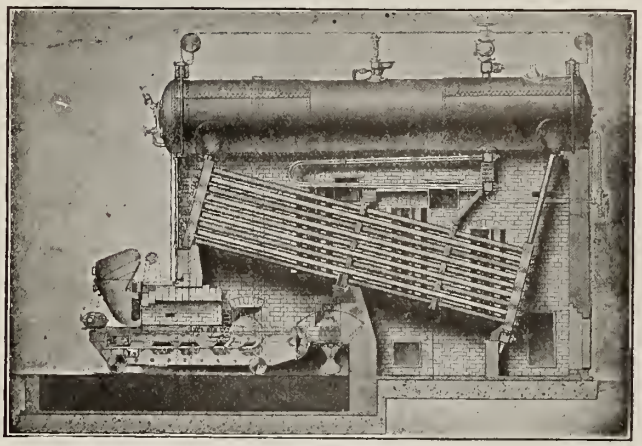
With Furnaces for all Classes of Fuel or Waste Gases

HIGHEST ECONOMY, SAFETY, DURABILITY OVER 8,000,000 IN USE



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Goodyear Tire & Rub. Co., Toronto.
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National Pipe Bending Co., New Haven, Conn.

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Canada Fdry. Co., Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Deming Co., Salem, O.
General Supply Co. of Can., Ottawa.
Hare Eng. Co., Toronto.

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Canadian Fairbanks-Morse Co., Ltd., Montreal.
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Babcock & Wilcox, Montreal.
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Jenckes Machine Co., Sherbrooke, Que
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Polson Iron Works, Toronto.
Robb Engineering Co., Amherst, N.S
Waterous Engine Wks. Co., Brantford

Boilers, Marine, Locomotive and Vertical.
Babcock & Wilcox, Montreal.
Goldie & McCulloch Co., Galt.
Canada Fdry. Co., Ltd., Toronto.
Jenckes Machine Co., Sherbrooke, Que
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Waterous Engine Wks. Co., Brantford

Buckets.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.

Cable Hangers and Supports.
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Corbet Foundry and Machine Co., Ltd., Owen Sound.
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Canadian Fairbanks-Morse Co., Ltd., Montreal.

Chemicals.
Dearborn Drug and Chemical Works, Chicago.
C. C. Snowdon, Calgary.

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Can. Gen. Elec. Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.

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Elmira Machinery and Transmission Co., Elmira.
General Supply Co. of Can., Ottawa.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
Waterous Engine Wks. Co., Brantford

Coal and Ash Conveyors.
Babcock & Wilcox, Montreal.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.

Coal Handling Machinery.
Hare Eng. Co., Toronto.

Cold Storage Architects.
E. J. Greenstreet, Toronto.

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Canadian H. W. Johns-Manville Co., Ltd., Toronto.

Condensers.
Alberger Condenser Co., New York.
American Steam Pump Co., Battle Creek, Mich.
Canada Fdry. Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
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Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
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G. M. Davis Regulator Co., Chicago.

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Laurie & Lamb, Montreal.
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Jas. Morrison Brass Mfg. Co., Toronto.

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Canadian General Electric Co., Ltd., Toronto.

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General Machinery Co., Toronto.
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Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
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Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

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General Machinery Co., Toronto.
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Keighley Gas Engine Co., Keighley, Eng.
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Canadian Fairbanks-Morse Co., Ltd., Montreal.
General Supply Co. of Canada, Ottawa
E. Leonard & Sons, London, Ont.
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Engines, Saw Mill.
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Robb Engineering Co., Amherst, N.S.
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Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Kerr Engine Co., Walkerville.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Vertical.
International Harvester Co. of America, Chicago.
General Supply Co. of Canada Ottawa
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.

Exhaust Fans.
General Supply Co. of Canada, Ottawa
Percival F. Gifford, Montreal.
Hare Eng. Co., Toronto.

Exhaust Heads.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Eadie-Douglas, Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia

Expansion Joints.
Alberger Condenser Co., New York.
Lunkenheimer Co., Cincinnati, O.

Feed Water Alarms.
H. L. Peiler & Co., Montreal.

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Dearborn Drug and Chemical Works, Chicago.
C. C. Snowdon, Calgary.

Feed Water Heaters.
Alberger Condenser Co., New York.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
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Darling Bros., Montreal.
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Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Goulds Pump Co., Montreal.
Hare Eng. Co., Toronto.
National Pipe Bending Co., New Haven, Conn.
H. L. Peiler & Co., Montreal.
Robb Engineering Co., Amherst, N.S.
The Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Canada Foundry Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.

Filters, Pressure.
Bell Filtration Co. of Canada, Toronto
Eadie-Douglas, Ltd., Montreal.

Feed Water Filters.
Bell Filtration Co. of Canada, Toronto

Fire Hose.
J. R. Baxter & Co., Montreal.
Dunlop Tire and Rubber Goods Co., Toronto.
Goodyear Tire & Rubber Co. of Canada, Toronto.
Quaker City Rubber Co., Philadelphia, Pa.

Fire Brick.
Alex. Gibb, Montreal.

Fireproof Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Flanges.
Dart Union Co., Toronto.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.

Flue Brushes.
General Supply Co. of Canada, Ottawa

Flumes, Steel.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
E. Leonard & Sons, London, Ont.

Freezer Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Furnace Linings.
Hare Eng. Co., Toronto.

Fuses.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto.

Gaskets, Rubber, Asbestos and Copper.
Can. Gasket Co., Bridgeburg, Ont.
Goetze-Gasket & Packing Co., New Brunswick.
Asbestos & Rubber Goods Co., Toronto.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Dunlop Tire and Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Canada, Ottawa

Gas Exhausters.
Hare Eng. Co., Toronto.

Gas Producer Plants.
Canadian Boving Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
E. Leonard & Sons, London, Ont.

Gauge Cocks.
Can. Fairbanks-Morse Co., Montreal.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
H. L. Peiler & Co., Montreal.

Gauge Glasses.
J. R. Baxter & Co., Montreal.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

Gauge Test Pumps.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.

Gauges—Pressure, Vacuum, Draft and Recording.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.
H. L. Peiler & Co., Montreal.

Gears, Cut, Worm, Mortise.
J. R. Baxter & Co., Montreal.

Gears, Spur Level.
Manitoba Bridge & Iron Works Limited, Winnipeg.

Generators.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal.

Graphite.
Jos. Dixon Crucible Co., Jersey City.
General Supply Co. of Canada, Ottawa
C. C. Snowdon, Calgary.

Graphitol.
British Pacific Supply Co., Victoria, B.C.

Grates.
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.

Grease Cups.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
Detroit Lubricator Co., Detroit.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
F. J. Schuch, Toronto.

Grease and Oil Extractors.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canada Foundry Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary.
Hare Eng. Co., Toronto.

Greases.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria, B. C.
Can. Fairbanks-Morse Co., Montreal.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Hangers.
Canadian Bond Hanger & Coupling Co., Alexandria, Ont.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Heaters.
Alberger Condenser Co., New York.
Canada Foundry Co., Toronto.
Darling Bros., Montreal.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Hare Eng. Co., Toronto.
E. Leonard & Sons, London, Ont.
H. L. Peiler & Co., Montreal.
The Stewart Heater Co., Buffalo, N.Y.

Hose, Flexible Metallic.
F. J. Schuch, Toronto.

Hose, Steam, Suction and Water.
Asbestos & Rubber Goods Co., Toronto.
J. R. Baxter & Co., Montreal.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto

Hydraulic Accumulators.
Canada Foundry Co., Ltd., Toronto.

Hydraulic Machinery.
The Deming Co., Salem, O.

Hydro Extractors.
Jones & Glassco, Montreal,

Ice Making Machinery.
Linde British Refrigeration Co., Montreal.

Indicators, Electric—All Types.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Indicators, Steam and Gas Engine.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Can. Fairbanks-Morse Co., Montreal.
H. L. Peiler & Co., Montreal.

Indicators—Ammonia, Hydraulic.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Detroit Lubricator Co., Detroit.

Injectors.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.

Insulating Tapes & Varnishes.
Standard Underground Cable Co., Hamilton, Ont.

Iron Filler.
Imperial Waste & Metal Co., Montreal.

Lamps, Tungsten, etc.
Canadian General Electric Co., Ltd., Toronto.

Lamps, Arc, Incandescent.
Canadian General Electric Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton
P. H. Klein, Jr., Co., Montreal.
Northern Electric & Mfg. Co., Limited, Montreal.
A. H. Winter Joyner, Toronto.

Lubricants.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria, B. C.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Lubricators, Force Feed.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
J. R. Baxter & Co., Montreal.
Darling Bros., Montreal.
Detroit Lubricator Co., Detroit.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N.Y.

Lubricators, Plain.
Detroit Lubricator Co., Detroit.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.

Mats.
Dunlop Tire & Rubber Goods Co., Toronto.
Goodyear Tire & Rubber Co. of Canada, Toronto.

Mechanical Stokers.
Babcock & Wilcox, Montreal.
Hare Eng. Co., Toronto.
Murphy Iron Works, Detroit, Mich.

Meters, Electric.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Meters, Water.
H. L. Peiler & Co., Montreal.

Mill and Mining Machinery.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
Jenckes Machine Co. Sherbrooke, Que
Madison Williams Mfg. Co., Lindsay, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Motors.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal.

Motor Starters and Controllers.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Office Railings.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Cups.
Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, O.

Oil Filters.
Canadian Oil & Waste Saving Machine Co., Ltd., Brockville.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Separators.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Liberty Mfg. Co., Pittsburg.
Jas. Morrison Brass Mfg. Co., Toronto.

Oils, Lubricating.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria, B. C.
Can. Oil Companies, Ltd., Toronto.
Dearborn Drug and Chemical Works, Chicago.
C. C. Snowdon, Calgary.

Packing Engine.
Asbestos & Rubber Goods Co., Toronto.
J. R. Baxter & Co., Montreal.
Can. H. W. Johns-Manville Co., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Canada, Ottawa
Goodyear Tire & Rubber Co. of Canada, Toronto.
Steel Mill Packing Co., Windsor, Ont.

Packing, Metallic.
Asbestos & Rubber Goods Co., Toronto.
General Supply Co. of Canada, Ottawa
Holmes Metallic Packing Co., Wilkesbarre, Pa.
H. L. Peiler & Co., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.
Rhodes Improved Metallic Packing Co., Ltd., Montreal.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
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Garlock Packing Co., Hamilton, Can.
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Goodyear Tire & Rubber Co. of Canada, Toronto.
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Packing, Sheet.
Asbestos & Rubber Goods Co., Toronto.
J. R. Baxter & Co., Montreal.
Dunlop Tire & Rubber Gods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
General Supply Co. of Canada, Ottawa
Goodyear Tire & Rubber Co, of Canada. Toronto.
Quaker City Rubber Co., Philadelphia, Pa.
F. J. Schuch, Toronto.

Packing, Ammonia, Steam and Water.
Asbestos & Rubber Goods Co., Toronto.
J. R Baxter & Co., Montreal.
Canadian H. W. Johns-Mansville Co., Toronto.
Dunlop Tire and Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
General Supply Co. of Canada, Ottawa
Goodyear Tire & Rubber Co. of Canada, Toronto.
Quaker City Rubber Co., Philadelphia, Pa.
F. J. Schuch, Toronto.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rubber.
J. R Baxter & Co., Montreal.
Dunlop Tire and Rubber Goods Co., Toronto.

Paints.
Can. Oil Companies, Ltd., Toronto.

Panel Boards.
Devoe Electric Switch Co., Montreal.
Hill Electric Switch Co., Montreal.

Packing Rubber.
Dunlop Tire and Rubber Goods Co., Toronto.
Goodyear Tire & Rubber Co., Toronto

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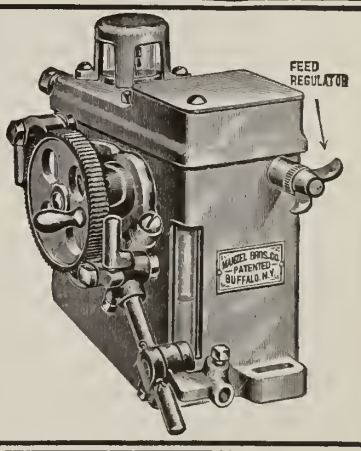

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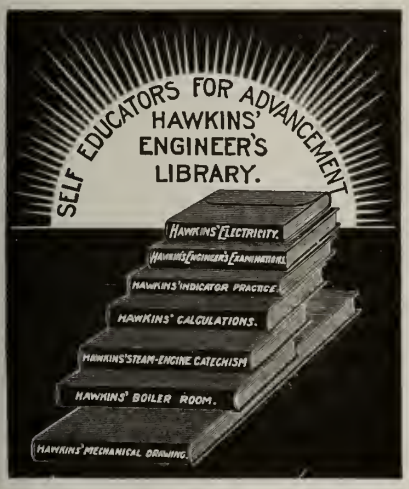

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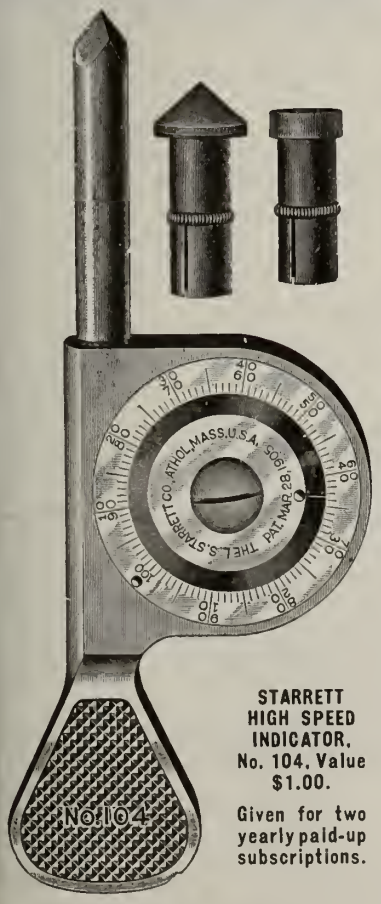

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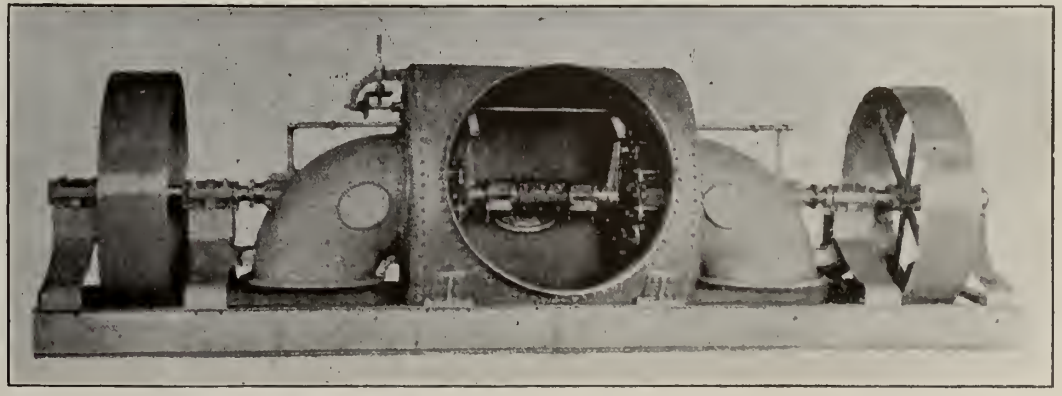

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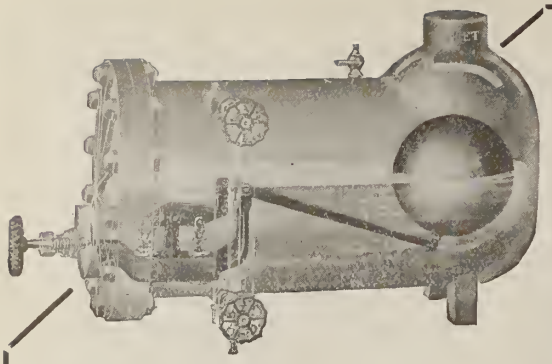

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removes *all* condensation without waste or loss of steam. It is a continuous flow trap. As fast as the water is formed it is automatically removed. The discharge may be against any pressure less than that in the trap. Having balanced valves, the Davis Trap will work equally well on 1 lb, or 200 lbs. pressure—it is a *general service* trap.

It requires little or no attention, is proof against clogging and can be easily repaired when necessary. It has renewable Tobin Bronze valves and seats which do not cut away quickly like a softer metal does, The Davis is a trap you can depend upon to keep steam transmission losses at a minimum.

Send for Trap Booklet

you'll be interested in the many valuable features of the Davis Trap—they make for increased steam economy. We will gladly send you printed matter on the trap and other valve specialties. *Write to-day.*

Jobbers and Dealers Everywhere Sell Davis Valve Specialties.

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ESTABLISHED 1875

Manufacturers of the Davis Pressure Regulator, Back Pressure Valve, Exhaust Relief Valve, Stop and Check Valve, Pump Governor, Balanced Valve and other specialties.

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Westinghouse

High Tension Type GA Oil Circuit Breakers

Westinghouse 66,000 Volt Type GA, Oil Circuit Breaker, Installed.

TYPE GA Oil Circuit Breakers will successfully handle high potential circuits ranging from 44,000 to 110,000 volts, and have a current-carrying capacity of 300 amperes within any of these voltages. Some distinctive features are:

Liberal insulation distances between live parts and to ground.

Ample break distances, insuring opening of the circuit without chance of arc holding between the contacts.

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Heavy boiler steel tanks with covers securely bolted on, making breaker capable of withstanding shocks incident to opening severe short circuits.

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INJECTOR

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"Morrison's" Products are backed by thirty years of successful service. They have proved their worthiness of a fair trial in your plant.

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Special Feature—Articles on Boiler Room Equipment

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Co., Limited.

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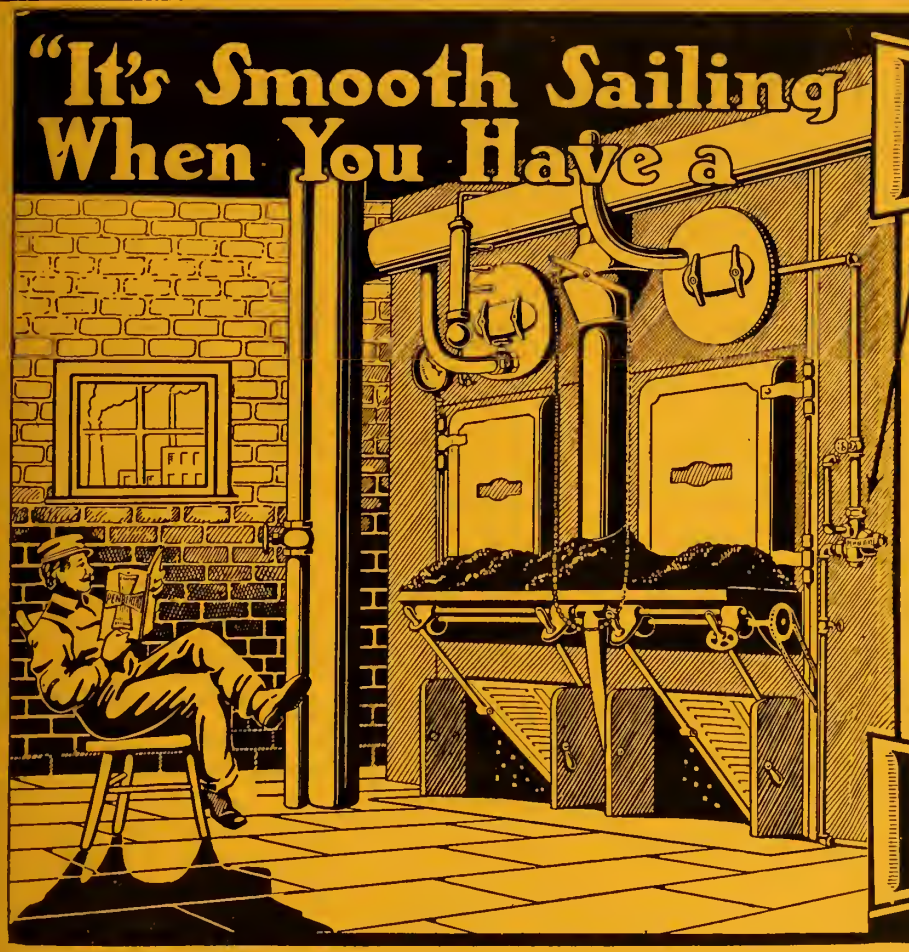
Vol. V. Publication Office, Toronto—June, 1912 No. 6

"It's Smooth Sailing When You Have a PENBERTHY



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The Best by Every Test.

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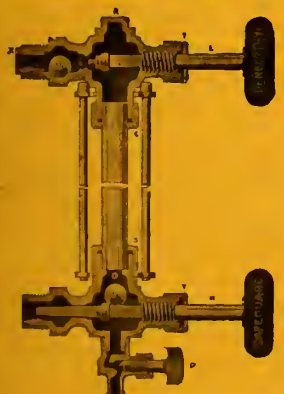

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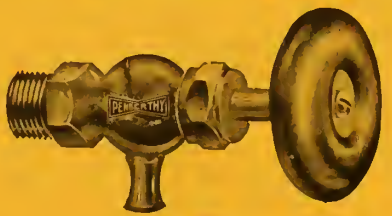
No boiler room should be without one.

Equip the Boiler with

RELIABLE FITTINGS



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and specify the other Penberthy lines such as Water Gage, Gage Cocks, Whistles, Safeguard Water Gages, etc.

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PLAIN STEAM WHISTLES

Manufactured by

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WINDSOR, ONT.

We make a Complete Line of Water Gage Mountings and Gage Cocks.

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Are your Pump Valves made to order? We make each individual valve order up special to cover your exact requirements. In this way you will do away with a great deal of valve trouble. We have facilities for turning out orders at short notice. We have just issued a little circular, which goes into the rubber pump valve question in the most complete way, that we would be glad to send you if you are interested. It covers the highest grade valve on the market for every use, and is a handy reference.

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Manufacturers of the Famous Rainbow Sheet Packing

H. D. EDWARDS & CO.

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Sole Agents and Distributors for the Dominion of Canada

"WATEROUS" Stamped on Your Boiler Means—

THAT it is not only designed to standard specifications, built of specified materials, and ested and inspected to conform to certain hard and fast inspection laws, but that it is turned out in one of the largest and best equipped shops in the country.

¶ It means that in its construction are combined exceptional shop facilities, high grade tool equipment, and the kinks and know-hows of 50 years boiler making experience.

¶ The name plate means more than that. It is a guarantee of boiler service, boiler quality, and boiler satisfaction that only a firm of unquestioned industrial and financial standing is able to give.

We back our Boilers to be "Built Right."

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RETURN TUBULAR
STATIONARY
PORTABLE
VERTICAL
MARINE
SPECIAL

All Sizes

The Waterous Engine Works Co., Limited

BRANTFORD, CANADA.

is scientifically prepared from chemicals that positively will not injure the boiler or fittings, but that act quickly on the scale forming and corrosive solids in the Feed Water, neutralizing and precipitating them in a harmless state, to be removed when the boiler is blown down or washed out.

This is the only Feed Water Treatment that completely eradicates all grease and oil from the boiler.

It can be used with absolute safety at all times, and will save much time and money by allowing your boiler to yield the highest efficiency at minimum fuel cost.

Years of experimenting and practical testing enable us to place an absolute guarantee on every package of this Compound that leaves our Laboratories.

If you are not using it now, it will pay you to investigate at once.

We treat each case individually on the condition that our treatment must prove a success and be absolutely satisfactory to you before you pay a cent.

Send us a gallon of your Feed Water for free analysis, and we will quote a price on a compound especially prepared for your plant.

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No. 11 Colborne Street - - TORONTO

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Boilers built to conform with the various Provincial Inspection Acts. A well assorted stock carried on hand constantly. Let us have your enquiries.

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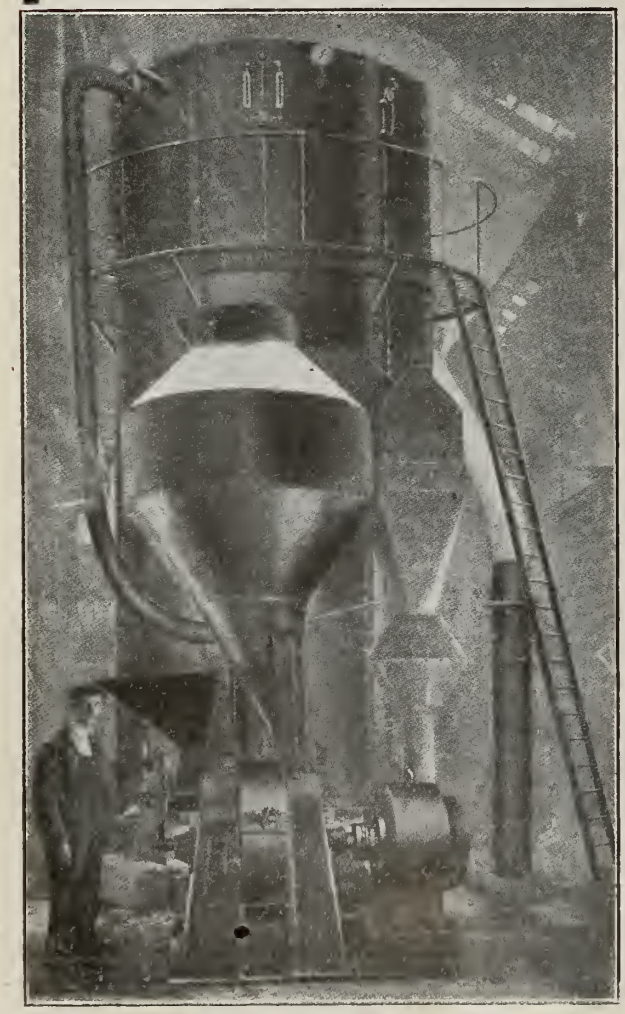
FUEL SAVER

BETTINGTON BOILER

After a long series of experiments we have produced this Boiler and Furnace, which, with pulverized fuel produces a saving that is remarkable.

From dirty small coal, and slack, considered unfit for use in ordinary furnaces, an evaporative efficiency result is secured equal to that from the best quality coal.



The mixture of air and fuel dust contains all the elements necessary for complete combustion.

To start the furnace the coal is fed into a hopper, the current switched on and a lighted torch placed above the fuel pipe, where it enters the furnace. This mixture of air and fuel dust forms a gas that ignites instanteously.

The Boiler itself consists of mild steel top and bottom headers, with steel tubes connecting. The top is fitted with doors for withdrawing the tubes.

This type of Boiler requires a very small stack. Owing to the perfect combustion there is no smoke, and a great saving in labor is effected as there are no fires to clean. No grates. Ashes do not adhere to the pit.

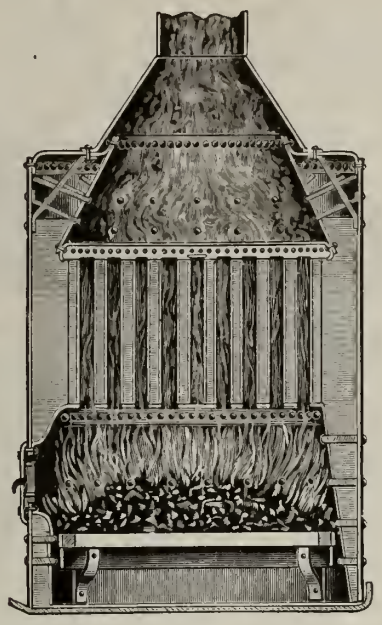
Steam can be raised from cold water to full pressure in 20 minutes. Boiler can be fired with waste gas if desired.

The tubes, being upright, are easily kept free from scale.

Better write us for full particulars on this up-to-date Boiler.

Fraser & Chalmers, Ltd.

MONTREAL, QUEBEC, CAN.



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We build various types: Scotch, Clyde, Fitzgibbon, Vertical, Mosher.

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GENERAL PLATE WORK

THE BEST MATERIAL, MANIPULATED BY EXPERIENCED WORKMEN, ENSURES A FIRST CLASS BOILER.

We Employ Both. ***Consult Us.***

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STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

TORONTO **CANADA**

REPRESENTATIVES IN CANADA FOR

The B. F. Sturtevant Co., Hyde Park, Mass., U.S.A., Fans, Blowers, Heating and Ventilating

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BOILER ENAMEL

is a guaranteed preventative of boiler scale, pitting, corrosion, priming, foaming, etc., which will work equally well in any class of feed water.

"ECLIPSE" is made entirely from tropical plants, and in the process of manufacture no chemicals of any kind are added. It is chemicals that prove disastrous to many boilers and their fittings.

Being harmless, it is slow in its action on old scale, but is deadly sure.

The cost of using "ECLIPSE" in your boilers cannot be compared with the great saving that results from its use.

PROFIT BY THE EXPERIENCE OF OTHERS by writing us for testimonials from many well-known firms in Canada who use this boiler enamel. Their verdict will convince you that "ECLIPSE" will save money.

We guarantee satisfaction, or money refunded.

It's a paying proposition. Write us at once.

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Walker's Electric Boiler Compound

has been on the market for over twenty-five years, and does all that we claim for it without the slightest injury to the tubes, packing or connections.

Will Remove Scale

We carry all kinds of high grade **Lubricating Oils, Greases, Packings,** and **Engine Supplies.**

WRITE TO-DAY FOR QUOTATIONS.

E. J. C. WALKER, Secretary — J. C. WALKER, President — S. T. WALKER, Director — C. H. WALKER, Director

The Electric Boiler Compound Co., Ltd.

Guelph, Ontario

Do You Know to a Pound How Much Coal Your Boilers Burn?

Don't You Want to Know?

FAIRBANKS' SUSPENSION COAL SCALE
Montreal Tramways & Power Co., Limited

Not knowing, to the pound, how much coal your boilers burn, how can you determine with any degree of accuracy the efficiency of your boilers? The true energy-producing quality of your coal? The cost of your power?

We show here a one ton Fairbanks' Suspension Coal Scale, with quick weighing dial, installed in the Power House of the Montreal Tramways & Power Co., Limited. With this scale they can check to a pound the amount of coal the boilers use.

The scale hopper is mounted on a trolley which runs on a track in front of the boilers and this trolley is operated by means of a motor controlled from the floor below. The scale hopper is filled from the overhead coal bunkers, the coal weighed, and the trolley is then run along the track until it is opposite the boiler you desire to feed. There the coal is dumped into the feed hoppers of the automatic stokers.

This scale should be in every up-to-date power house. It can be adapted to meet your requirements. Let us know what the conditions are in your power house. Write for further particulars.

The Canadian Fairbanks-Morse Co., Limited

FAIRBANKS' SCALES—FAIRBANKS' VALVES—FAIRBANKS-MORSE GAS ENGINES, SAFES, VAULTS, Etc.

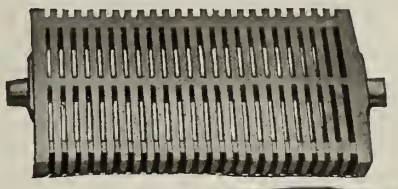
Montreal St. John Ottawa Toronto Winnipeg Saskatoon Calgary Vancouver Victoria

BEWARE OF IMITATIONS

"THE Cyclone"

Shaking and Dumping Grate Bar

LEADS THEM ALL



Toronto, November 21st, 1911

Messrs. Canadian Steam Boiler Equipment Co., Ltd.
186 Queen Street East
City.

Gentlemen:—

In reply to your enquiry of the 21st, re the Cyclone Shaking and Dumping Grate Bar, we may say that we think we were the first people to use shaking and dumping grate bars on a brick kiln, viz., those you supplied us with four years ago. I have examined this grate bar and find that they are just as good as the day they were installed.

The last kiln you equipped with the improved Cyclone Grate Bar is giving excellent satisfaction and I think that the best testimonial that I can give is the fact that a few days ago I gave an order for another set of grates for my boiler, as I consider the installation of these grates will very soon pay for itself. They are saving probably 25% of my fuel bill.

Yours very truly,

(Signed) ISAAC PRICE.

The EVIDENCE of a User

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST - - - - TORONTO, CANADA

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HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.

Every Up-to-Date Plant Should Investigate

The "Stanlock" System

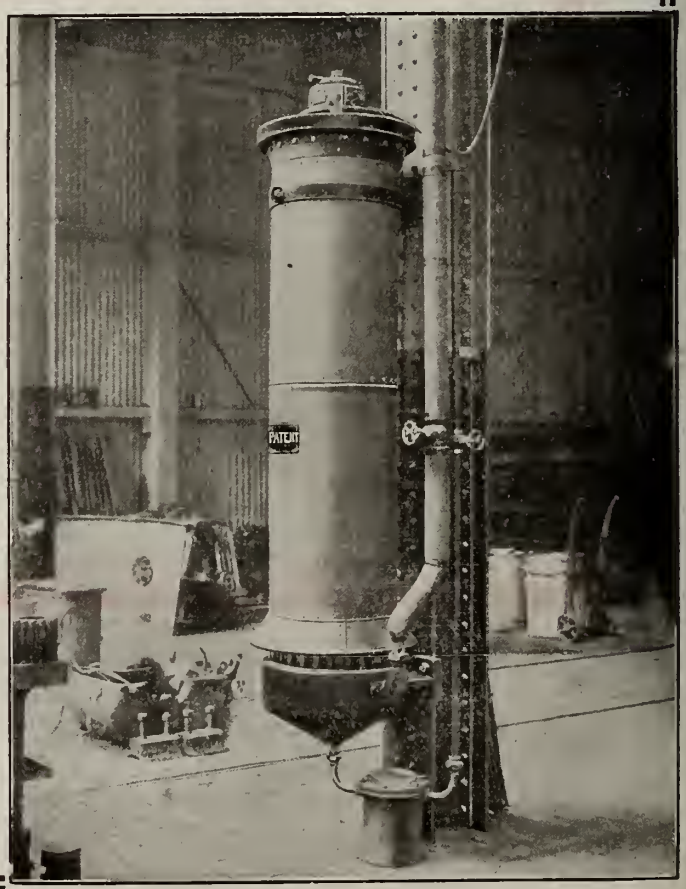
of

Heating and Ventilating

This system consists of units as shown below. They are made of steel tubes screwed into circular cast iron bases and through these tubes steam passes. Enclosing these tubes is a sheet metal cylindrical casting with a motor at the top. The air is forced downwards, thus keeping the floor warm. A special pipe can be fitted, passing through the roof or through the side wall, thus giving a supply of fresh air. Dampers are provided so that the inside air can be circulated or outside air can be taken in and heated.

Advantages of the "Stanlock" Multiple Unit System

1. No overhead air ducts are required.
2. No underground masonry ducts are required.
3. No obstruction to light due to overhead air ducts.
4. No heat losses due to radiation from air ducts.
5. Minimum of power absorbed.
6. Units hung on walls. No floor space needed.
7. Various units operated independently and can be turned on or off like radiators. Some supply fresh heated air and others merely circulate and heat.
8. A unit using 60 lb. steam pressure heats 3,600 sq. ft. of floor space.
9. The first cost of apparatus is very low.
10. Units may be added at any time in case of extensions, and in case of boiler shops, units may be removed entirely during the summer months, if desirable.



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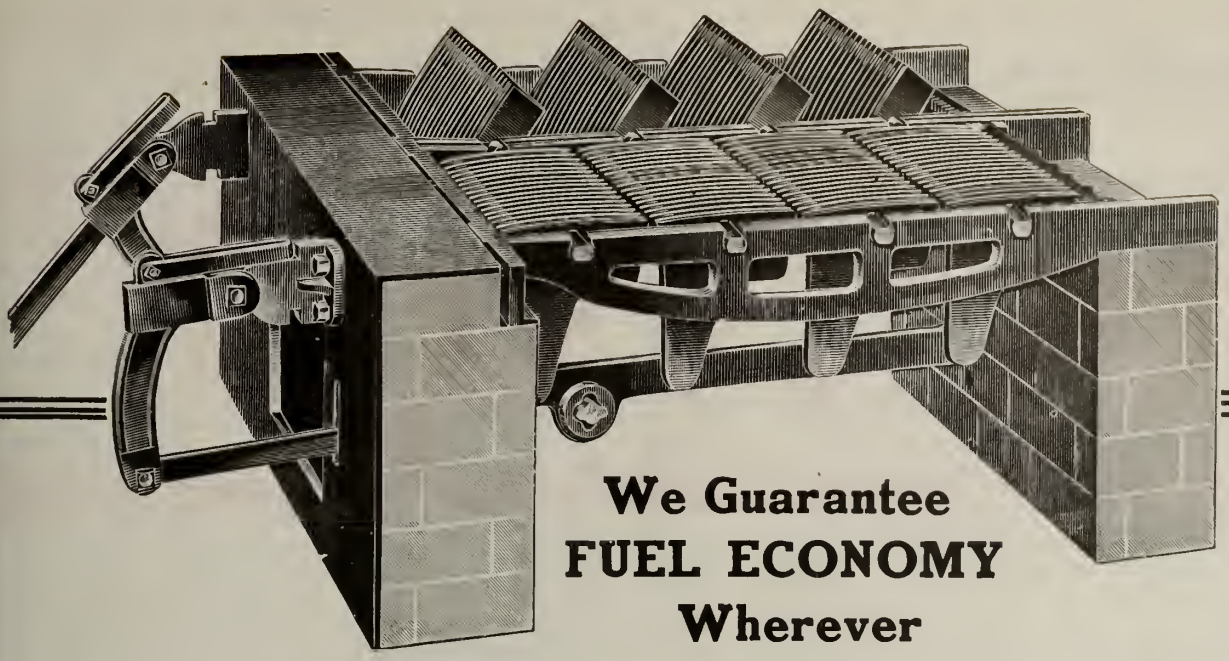
Selling Agents for the Dominion of Canada

26-32 Craig Street West - MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.



We Guarantee
FUEL ECONOMY
Wherever
The

20TH Century Grate Bar

Is Installed

This Grate has no weak spots. It cannot warp or burn out. Has more air space than any other grate, and greater dumping capacity for the removal of clinkers.

Those who are using **20th Century Grates** are highly enthusiastic ovcr the results. We have letters from these users—letters that will convince you of its economy. Write for them.

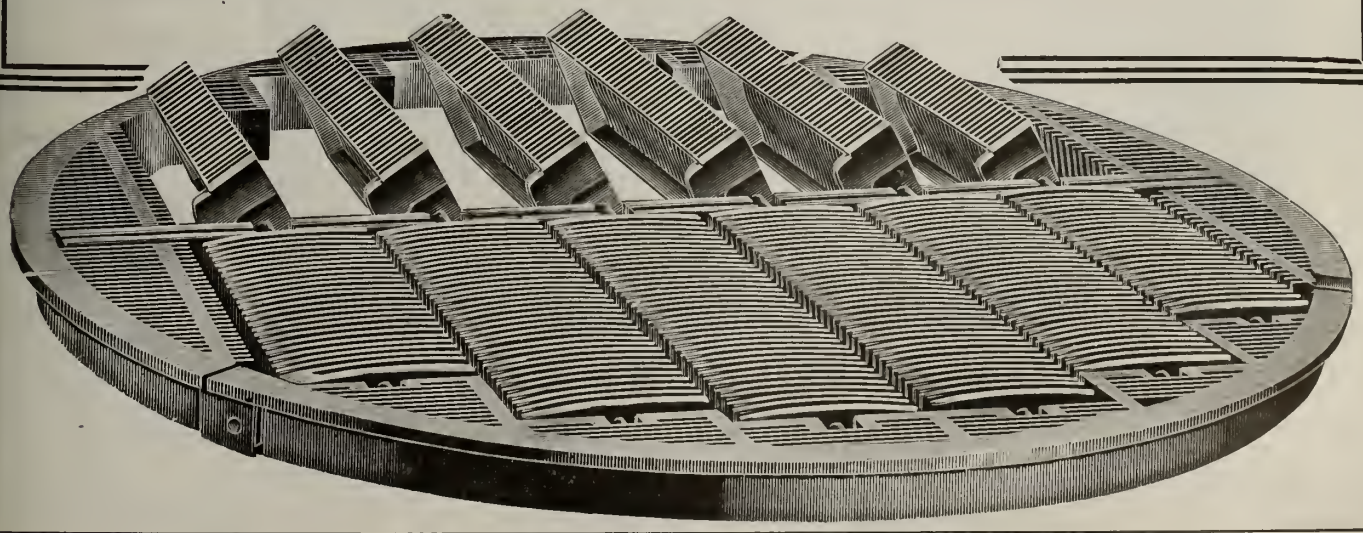
We install the **20th Century** in every type of furnace, brick kilns, and gas producers. They burn the **cheapest grades of fuel** with maximum results.

Communicate with us NOW

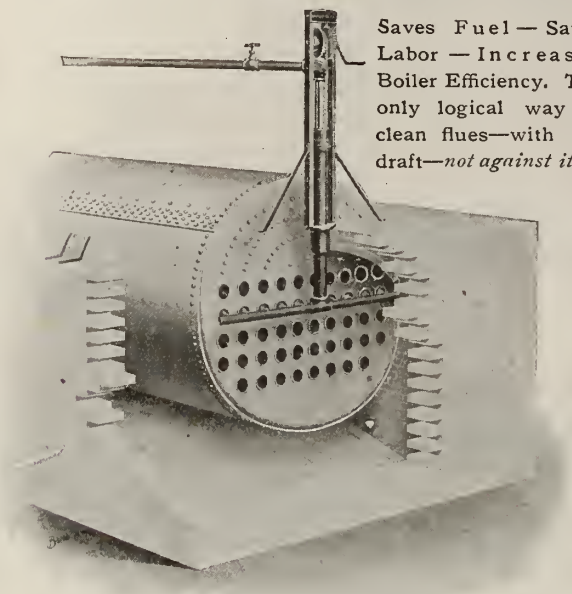
The Boiler Repair and Grate Bar Company

Room 217 St. James' Chambers, 69 Adelaide Street East, Toronto

Circular Grate, designed by Adam Hett for W. M. Lowney's Chocolate Works, Montreal.



'THE HENRY' STEAM FLUE CLEANER



Saves Fuel — Saves Labor — Increases Boiler Efficiency. The only logical way to clean flues—with the draft—*not against it.*

Write to nearest Representative for Catalog and Particulars.

THE STEAM APPLIANCE CO.
MILWAUKEE, WISCONSIN.

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Eastern Agent:
ENGINEERS REPRESENTATIVE CO.
201 Board of Trade Bldg. Montreal.

Highest Grade
BOILERS

Tapered Shell Upright Submerged Tube Boiler.

Vertical or Horizontal

Before installing a new Boiler communicate with us. Get acquainted with our

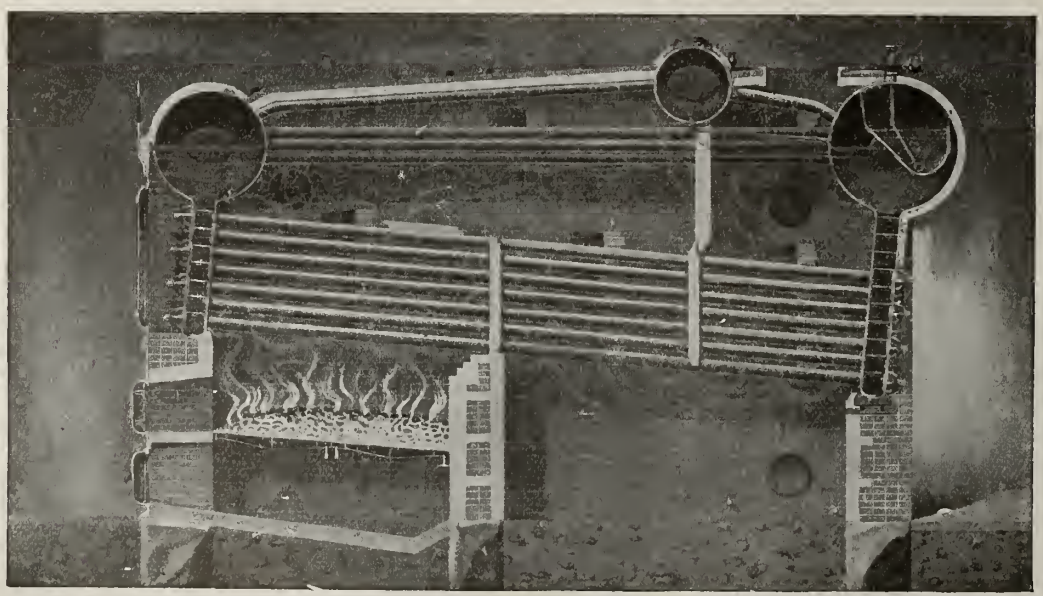
Tapered Shell Upright Submerged Tube Boiler

it is the assurance of good service and has reached the highest point of boiler perfection.

Send us your inquiries for full particulars.

The Alex. McKay Boiler Works
Office and Works: 1194 to 1206 de Montigny St.
MONTREAL

Canada Water Tube Boilers



Save Coal

Superheat Steam

Purify Feed Water

CANADA FOUNDRY CO., Limited,
Head Office and Works: TORONTO.
District Offices: Montreal, Halifax, Ottawa, Cobalt, South Porcupine, Winnipeg, Calgary, Vancouver, Nelson, Prince Rupert, B.C.

Thomas Elliptic Grate Bars

DESIGNED to produce a bar that would give long, hard use under adverse circumstances—everlasting.

TEST produced a bar that expelled ashes and slag clinker making matter in its molten state, but not dirt clinkers—self cleaning.

CONSTRUCTION Two oppositely curved surfaces joined t ogether at intervals with connecting and spacing lugs. All parts scientifically arranged.

ADVANTAGES Easy Firing—Increased Steam—Less Fuel Used. Being circular has great strength and is adaptable to every kind of fuel and all kinds of draft spaces; having open spaces in the sides keeps the lower part cool by a lateral draft radiating the heat from the connecting lugs and prevents crystalizing, which gives long life. The top surface being oval, sheds the ashes automatically and the molten clinker making matter rolls off in its molten state in the form of a cinder, thus eliminating slag clinkers, which gives a clean fire at all times. The bottom surface being oval has great strength and holding power and with the draft spaces in the sides protecting it from the heat, gives it a long life. Has 20% more grate surface than flat top grates same area.

They Save You Money Because

THEY LAST LONGER **INCREASE BOILER POWER** **SAVE FUEL** **SAVE LABDR**

They are made of PIG IRDN of special analysis—heat resisting, Their construction is practical and scientific—last longer. Their operation is the shedding of ashes and slag—self-cleaning. Their shedding ashes burns the fuel better and aids combustion. Their shedding slag eliminates the formation of slag clinker. Their self-cleaning effect reduces labor in cleaning fires. Their reduced consumption of fuel reduces labor of handling fuel. Their self-cleaning increases combustion through open draft spaces. Their increased combustion secures additional heat units. Their increased heat units give increased boiler power. Their increased boiler power increases plant efficiency. Increased plant efficiency reduces cost of output.

They will not

Shed dirt or sand, which melts into a sticky, gummy mass that spreads out over the surface of the bars like gum, and does not separate itself into particles and run like iron or slag—this is glass, and can only be expelled through the fire door with a hook.

Made with every style of Draft Openings
FOR EVERY FUEL

For **USE** in Locomotives, Steam Boats, Saw Mills. Planing Mills, Ice Plants, Water Works. Electric Light Plants, Cotton Mills, Fertilizer Plants. Mines and everywhere steam is made.

SIZES Elliptic Bars are 6 inches wide and any length.

Let us send you a list of more than 500 steam users in the States who are giving 2nd, 3rd, 4th, 5th, 6th, 7th and 8th repeat orders. Or send us a trial order for prompt shipment from Hamilton, and let the BARS demonstrate their value and worth.

The General Supply Co. of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

Thomas Grate Bar Co., Birmingham, Ala., U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

GOETZE'S VALVE GASKETS SAVE TROUBLE AND MONEY

THEY ARE FOR VALVES OF THE JENKINS TYPE
AND ARE MADE OF COPPER AND ASBESTOS

One Goetze's Valve Gasket will outlast six rubber discs, because it will not crack and go to pieces as rubber does. That's why Goetze's Valve Gaskets are cheapest from beginning to end.

Order your new valves fitted with Goetze's Valve Gaskets and have no more trouble with leaks. Use Goetze's Valve Gaskets to give your old valves a new lease of life. Only be sure you get *Goetze's*.

That Joint That Gives You So Much Trouble Can Be Made *Tight*

To put a gasket on the least troublesome flange joint in your plant is no real test of the value of that gasket. Put it on the *worst* joint, the one that is always giving you trouble, and you'll find out whether it is any good for your purpose or not.

We tell you that you can put a complete stop to all trouble due to leaky flange joints, that you can make that joint which gives you so much trouble absolutely tight

By Using Goetze's No. 2 Gaskets

And we are willing to prove it to you by shipping you any quantity on *90 days' trial*—no charge if they do not make tight joints and *hold* them tight under all pressures and temperatures. Try them. Write us to-day what sizes and quantities to ship. Remember, they do not cost you a cent unless they do the work. And be sure to ask for a copy of our Illustrated Catalog of Packings for all Power Plant Purposes.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

St. John, N.B.

BRANCHES AT

MONTREAL
163 Esplanade Ave.

WINNIPEG
C. E. Chown, 147 Bannatyne Ave.

VANCOUVER
A. O. Campbell, 1069 Hamilton St.

MANUFACTURED BY

Goetze Gasket & Packing Co.

NEW BRUNSWICK, N.J.

The advertiser would like to know where you saw his advertisement—tell him.

Garlock Rubber Valves

The successful working of a pump depends largely on the valves, and it is necessary that they should be made in the best possible manner and suitable to the work required. We have given this branch of our business careful study and are in a position to furnish valves properly adapted for the work intended.

When ordering please specify following qualifications:—Dimensions, size of hole (if any) thickness, round or square, for use in hot or cold water, and whether soft, medium or hard.

No. 80. Hot Water pressure, 250 lbs. temperature, not less than 180 degrees or more than 300 degrees, also for Oils, Naptha, etc.

No. 88. Warm Water 100 lb. pressure, cold water 50 to 400 lbs. pressure.

No. 93. Cold Water to 150 lbs. pressure, or 100 lbs. to 180 degrees.

No. 94. Cold Water to 150 lbs. pressure.

No. 15. Cold Water pressure to 75 lbs. condenser air pumps, 120 degrees to 180 degrees moderate pressure.

No. 151. Soft for Air.

No. 152. Red Condenser, light weight, durable and flexible.

No. 149. Soft for low pressure Cold Water.

No. 182. Medium Hard Valve for Cold Water from 150 lbs. to 400 lbs. pressure.

No. 108. Hard or Hot Water.

Prices on application.

We have other stocks to meet various conditions. Write for information and Garlock Catalog showing

"Packings for Every Purpose."

The Garlock Packing Co.

Head Office and Works: HAMILTON, ONT.

BRANCHES:

MONTREAL, QUE., 412 St. James St. TORONTO, ONT., 77 Adelaide St. E. WINNIPEG, MAN., 117 Market St. E.

"Pioneers in the Packing Business."

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY

Study This FREE Book Ten Minutes Daily

and within a month you will be better qualified than ever before to get the most efficiency out of your plant. This means more money and satisfaction from your work. We make no charge for the book. Simply comply with the easy requirements stated in the coupon below.

How to get the Hand-book FREE

Fill out the Coupon and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and look at Daniels' P.P.P. Packing.

YOUR NAME. .....
ADDRESS .....
EMPLOYED BY .....
ADDRESS .....
HORSEPOWER OF ENGINE .....
KIND OF ROD PACKING USED .....
DO YOU USE EBONITE SHEET PACKING? .....
BUYER'S NAME .....
DEALER'S NAME .....
ADDRESS .....
..... Series 24-F

If your dealer doesn't carry P.P.P., we will write telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

Three Rings of P. P. P. Will Keep Your Engine Packed All Summer

Your engine is a "packing eater," if it wears out a single lot of P.P.P. inside of several months. The experience of thousands of engineers proves that three rings of P.P.P. keep their engines packed for from three to six months. Some records show over a year's service.

Daniels'
P. P. P.
Rod Packing

gives and takes with the motion of the rod and the steam pressure. The pressure on the rod is never in excess of the requirement, which means no loss overcoming unnecessary friction. Send for a FREE sample and a copy of "The Story of Some Friction Tests."

THREE STYLES—"Regular," "Special" and "Marine." All styles are furnished in Coil, Spiral and Ring forms.

FREE To Users of P.P.P.

If you are a user of P.P.P., fill out the coupon and mail it to us. We will send the Engineers' Examination Book to your dealer (or one we name) who will hand it to you when you call at his store and look at Daniels' EBONITE Sheet Packing.

To better protect P.P.P. users against imitations, we have adopted a red "D" with a diagonal line across it.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

PHILADELPHIA, PA., U.S.A.

Seven Great Money-Saving Packings

Engineers and machinists throughout the Dominion are saving thousands of dollars in ***time alone*** by using Goodyear Packings—***short-cuts*** to ***RESULTS.***

Installed quickest and most easily. ***Outlast*** all others. Recognized by all who ***know packings*** as the highest standard of excellence. Use one of these great

GOODYEAR Packings

MAGNET SHEET PACKING

Meets *every requirement*—Boiler Room or Machine Shop. Made of special compound that *resists heat*, hence the *only* packing thoroughly adapted for high pressure uses. Makes tight joint under air or hot or cold water pressure. *Unaffected* by oil, liquor, ammonia or alkali. Retains elasticity.

MAGNET GASKET TUBING

For high pressure. Like Magnet Sheet Packing, this tubing is unaffected by heat, makes tight joint, can't *blow out*. Cut any length to fit any size manhole, hand-hole, plate or pipe flange. Put up in convenient boxes with rubber core and tape.

ROUND DUCK PACKING

Fine quality cotton duck with round core. Used like Hydraulic Packing, *only for lower pressure.*

HYDRAULIC PACKING

Best packing for pump cylinders, inside-packed plungers pumping hot or cold water, and hydraulic elevators. Unexcelled for boiling water and high pressure hydraulic work

CLOTH INSERTION PACKING

For cold and warm water pipes. Unexcelled in pliability, smoothness of finish and strength of cloth insertion. Made of heavier fabric than any other similar packing on the market.

SQUARE DUCK PACKING

Good quality cotton duck and friction to stand cold water. Cut accurately into squares.

SQUARE DUCK WITH RUBBER BACK

Specially adapted for elevator use. Made of superior cotton duck, gum back. Makes packing tight, practically no friction. Gives many times service of other packings of same nature.

VALVES

Unaffected by oil. Used in hundreds of industrial plants. Specially made to meet specific conditions.

Goodyear Packing, Belting, Hose and other rubber sundries enable you to capitalize the brains and experience of the world's greatest rubber goods experts—the knowledge and skill that underlies our reputation as well as that of the Goodyear Tire & Rubber Company, Akron, Ohio, the best known plant of its kind in the United States.

Our Sales of the last four months 50 per cent. greater than those of last year. Defective goods returned only $23.93.

Get in touch with us at once

The Goodyear Tire & Rubber Company of Canada, Ltd.

General Offices—Toronto Factory—Bowmanville, Ont.

Write Our Nearest Branch

BRANCHES—Montreal—Winnipeg—St. John, N.B.—Vancouver—Calgary

Victoria, B.C., 855 Fort Street; Regina, Saskatchewan, 2317-2318 South Railway Street; Hamilton, Ont., 127 King Street West

18

The advertiser would like to know where you saw his advertisement—tell him.

The Murphy Automatic Smokeless Furnace

Commercially on the market 30 years. It is not an experiment.

See advertisement in the Power House, page 26, May, 1912.

Repeat Orders Are the Best Evidence of Merit.

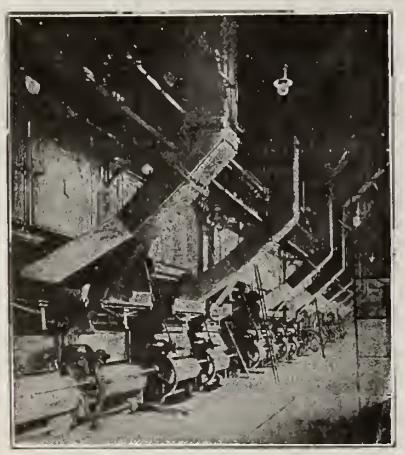
In March, 1905, we contracted with the Laurentine Paper Co., Grand Mere, P.Q., for Murphy Furnace Equipment for nine 250 H.P. water-tube units. It was arranged that three units should first be shipped and, if our guarantees were sustained by tests, then the other six units to be shipped quickly. The first three units were installed, test demonstrations showed economy in coal alone at the rate of more than $20,000 per year; the six remaining units contracted for were shipped.

1st order March, 1905, nine furnaces, 2250 horsepower.
2nd order July, 1907, two furnaces, 800 horsepower.
3rd order April, 1912, two furnaces, 800 horsepower.
4th order May, 1912, one furnace, 400 horsepower.

"THERE MUST BE A REASON."

If you desire catalog, test data, etc., write:—

MURPHY IRON WORKS, DETROIT, MICH. BUFFALO, N. Y.



"Bennis" New Link Chain Grate Stokers.

Bennis Chain Grate Stokers
Bennis Coking Stokers

and Patent Self-Cleaning Compressed Air Furnaces for Water Tube and Horizontal Return Tubular Boilers.

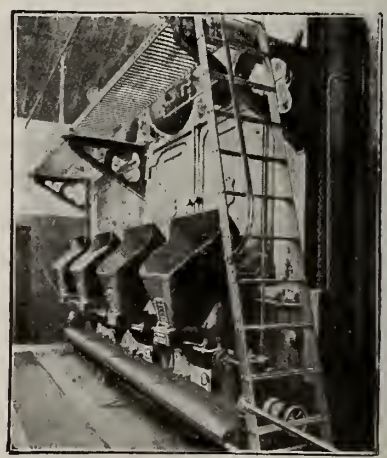
Bennis Machines are supplying over 3½ Million Horse Power and are saving Millions of Dollars a Year.

"BENNIS" machines feed the fuel where the fire requires it, keep the fire at a nicely calculated distance from the boiler front, and respond to varying loads with a rapidity that is the outcome of good design. They ensure the maximum results from the boilers, reduce the fuel bill, and keep clean chimneys because they ensure good combustion.

"Bennis" stokers are not simply made from one design and adapted to meet the requirements of different types of boilers, but are specially designed for the various types, constructed with the greatest care and fitted to meet individual conditions.

The greatest economy is achieved when Bennis elevating and conveying plant feeds the stokers. "Bennis" coal and ash-handling plant has acknowledged advantages over other types, not only in design and construction, but in the small amount of power required to operate it effectually.

Write for "Boiler-House Economy" pamphlets and full particulars to



For Cheap Steam without Smoke from water-tube boilers install "Bennis" Machine Stokers.

GEO. H. TOD, 213 Manning Chambers, Queen St. West, **TORONTO**

L. S. DONALDSON, "Glass Block:" Minneapolis, Minn.

Absolutely certain THEIR Stack is Clear!

Because Twelve Jones Underfeed Automatic Mechanical Stokers are firing their boilers.

YOU can be absolutely certain too regarding YOUR plant! "Abating the smoke nuisance is like giving **two** thoughts for yourself and **one** for your neighbor. You save money while acquiring a reputation for public spiritedness!"

THE JONES STOKER abates smoke by PREVENTING its formation!

THE JONES STOKER saves fuel by promoting perfect combustion and loses none through grate bars!

THE JONES STOKER increases the boiler horse-power developed, by its unlimited capacity to feed coal and simultaneously introduce the extra air required in the proper proportion for the combustion of same!

THE JONES STOKER maintains a constant steam pressure because of the automatic control of the air supply and the coal supply by the steam pressure itself!

THE JONES STOKER immediately responds to fluctuating loads and sudden demands for steam!

THE JONES STOKER preserves the heating surfaces of the boiler free from soot deposits due to perfect combustion!

THE JONES STOKER cost for maintenance is low because there are no moving parts in contact with the fire!

By installing a JONES STOKER in a small plant smoke abatement is made just as effectual, economy just as much a consideration relatively as in a large one.

JONES UNDERFEED STOKER COMPANY, Limited

National Trust Building, TORONTO.

J. V. Jamison, President. T. B. South, Vice-President. J. V. Jamison, Jr., Treasurer.

This "Ad" is addressed to users of

Refrigerator Doors, Windows and Ice Chutes

in Canada

for Cold Storage, Meat, Fish, Dairy, Poultry, Fruit and Vegetable products.

We guarantee our Doors not to sag or stick in the frames.

Our Hardware weighs 60 lbs. to set.

We manufacture or sell nothing else.

Our entire time and forces are directed to this line.

We supply

Linde British Refrigeration Co.
Linde Canadian Refrigeration Co. of Canada.
Armour & Co., Chicago, Ill., U.S.
Swift & Co., Chicago, Ill., U.S.

with all they use. Our latest orders are to Swift & Co., for Toronto, Can., 30 Doors; Canadian Fish and Cold Storage Co., Prince Rupert, B.C., 110 Doors.

Send for Catalogue

Jones Cold Store Door Co.

HAGERSTOWN, MARYLAND, U.S.A.

THAT DEVICE

WILL INCREASE HORSEPOWER AND SAVE FUEL

Do you need more power? Do you want to cut down fuel bills? If so you had better investigate

"The Typhoon" Turbine Blower

Find out what it is doing for others by writing us for testimonials. Then you will **be convinced** that this Blower is a necessity to your Boiler Room.

This System of Mechanical Draft permits the use of the cheapest grades of fuel, yet in many cases produces better results than the natural draft. You will secure complete combustion and increased boiler rating.

Can be automatically controlled so that it will stop and start with a rise and fall of temperature.

WRITE TO-DAY.

The Hare Engineering Co., Limited

14-16 King Street East, TORONTO

Interior View
Casing Removed

"DART" UNIONS

Make Pipe Connections That CANNOT LEAK or Corrode

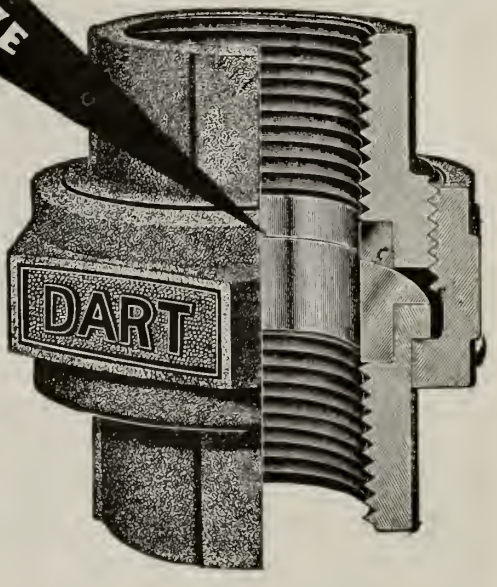
BRONZE TO BRONZE

The Bronze to Bronze Ground Ball Shaped Joint allows a quickly and easily made connection whether pipes are in or out of line.

Dart Unions are economical because they can be connected and disconnected time after time, and still retain their high efficiency.

They are durable, and not affected by contraction, expansion or vibration.

The trade mark that is found on every Dart Union is our guarantee. Every Union bearing this mark will be replaced 2 for 1, if not found entirely satisfactory.



DART

If you are not familiar with Dart Unions, ask your dealer to show them to you. You will readily see why they are a union of the highest quality.

Made in screwed, flanged, tee and elbow types, male and female.

Dart Union Co., Limited
Toronto, Ont.

The advertiser would like to know where you saw his advertisement—tell him.

TRADE JENKINS MARK
Jenkins Bros.

TRADE JENKINS MARK
Jenkins Bros.

"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

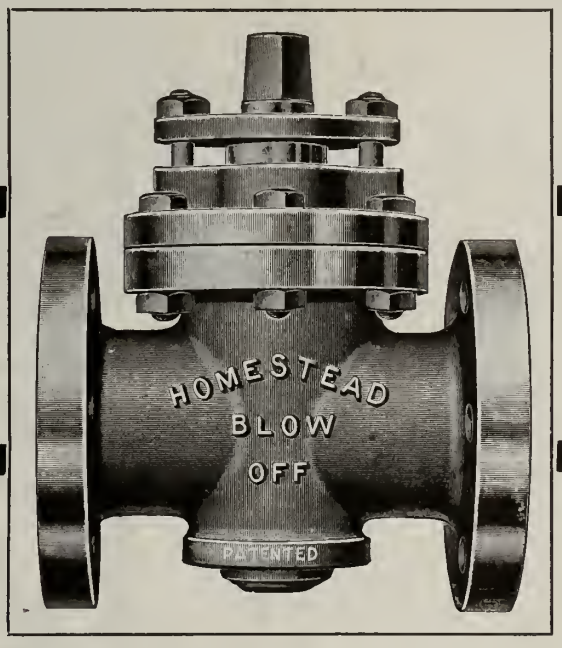
The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for ***genuine*** "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL

HOMESTEAD

HOMESTEAD VALVES are particularly qualified for difficult service. It's their substantial construction that makes them suitable for any service, especially for severe work in handling high steam, air or hydraulic pressures. They are superior to others because of the high quality of the material put into each valve and the unusually simple method by which they operate. To open or close the Homestead, all that's necessary is a quarter turn. No lost motion, no loss of steam, no waiting. When it is closed, our patent locking devise forces plug to seat and holds it there, absolutely tight. In opening, the plug is balanced and held in place



by the pressure. The seats are absolutely protected from wear when pressure passes through, and friction from either pressure or operation is entirely eliminated. Put your difficult valve problems up to us. we are specially fitted to solve them, and can do more than merely furnish the valves. At any rate, send for our illustrated booklet. It thoroughly describes our products:

Homestead Self-Locking Straightway, Three-way and Four-way High Pressure. Plug Valves, and Homestead Locking Cock

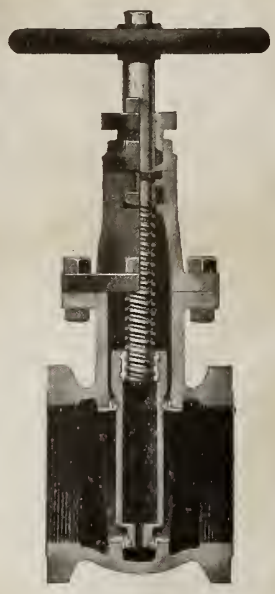
Homestead Valve Mfg. Co.

Works: Homestead, Pa. P.O. Box 1754, Pittsburg, Pa.

HOMESTEAD

The advertiser would like to know where you saw his advertisement—tell him.

6 inch Screwed
Iron Body Gate Valve



6 inch Interior Veiw
of I. B. B. M. Gate Valve

KERR

IRON BODY

GATE VALVES

The above illustrations are of the new "KEYSTONE" pattern gate valve which we are now shipping to our customers, and which is being so favorably commented upon by all who have as yet seen them, owing to their modern equipment and strong compact design.

See that

KERR

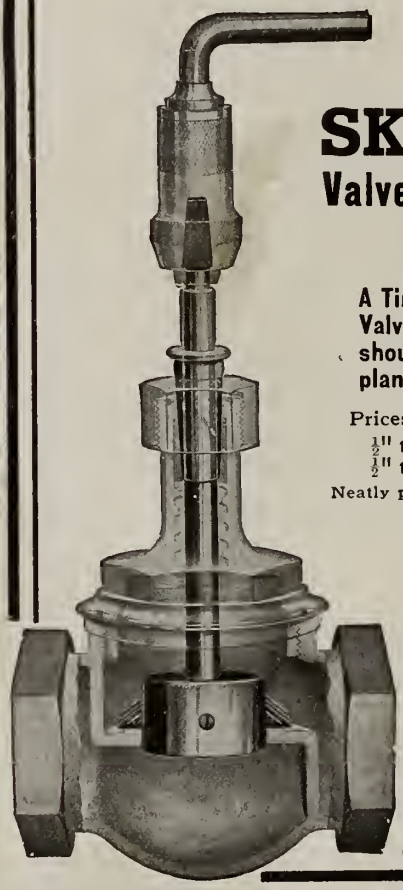
is on the body of the next valves you buy.

Specify them, and you'll get them.

The Kerr Engine Co.

LIMITED

WALKERVILLE - - ONTARIO



The SKINNER Valve Re-seating Tool

A Time, Money and Valve Saver which should be in YOUR plant.

Prices f. o. b. Montreal
½" to 2" - $20.00
½" to 3" - $30.00
Neatly packed in wooden box.

H. L. Peiler & Co.

380 St. James St.
MONTREAL

69 Adelaide St. E.
TORONTO

McLeod Bldg.
MONCTON, N.B.

W. E. Skinner, Ltd.

618 Somerset Bldg.
WINNIPEG

These are the telling points about

Bakelite

Valve Discs

They will not leak under high temperature, excessive pressure or when used in acids or other special liquids. Neither cold water, dry or superheated steam has the least effect upon them. **BAKELITE** Discs are a gas-tight fit.

BAKELITE is a successful substitute for expensive metal. Its structure is fibrous, giving strength and hardness. It can be reground and refaced, always retaining a uniform surface. It cannot be injured, except by accident or friction. Remember Bakelite **PUMP VALVES** do not warm with changes of temperature.

Order your valves fitted with Bakelite Valve Discs and stop that perpetual annoyance and expense caused by leaking valves. Depend upon it, Bakelite Valve Discs will not leak.

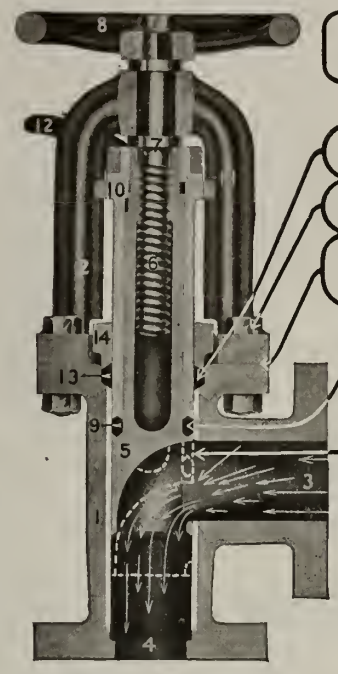
WRITE FOR PRICES OR ASK YOUR DEALER.

PLASTICS, Limited, - Van Horne St., TORONTO

Sole Agents for Alberta, Saskatchewan and Manitoba.
Bakelite Valve Discs and Pump Valves.
GENERAL SUPPLY CO. of CANADA, LIMITED, Winnipeg.
Head Office, Ottawa. Branches: Winnipeg and Toronto.

How the Nelson Blow-Off Valve Differs from Others

Sizes 1½ in., 2 in., 2½ in. and 3 in. Iron Body, for 300 pounds working pressure. Steel for extreme service. Also made in Straightway Type, same sizes, iron or steel.



Will Not Leak

Has No Seat

You adjust this packing by bolted gland, *without affecting the lower packing*. Compression not only independent, but positive.

Through bolts used exclusively, won't rust tight. We *never* use studs—they give the engineer trouble, when they break off.

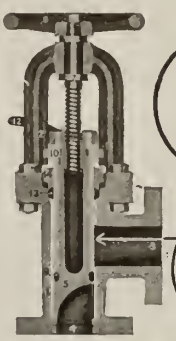
See the *rigid* joint, *machined* accurately, plunger *does not wabble*, always in line, gives that *easy opening* effect only found in the Nelson; opens easily, not only when new, but after opening it daily through a life-time.

This packing adjusted by lever wrench, also *independent*, also *directly compressed*, note V-shaped recess in which packing is secured.

Adjustment of either packing takes but an instant of time and is required only occasionally. The packing is specially adapted to its work and has very long life.

When partly opened a little sheltered bay is formed here (see dotted line), and the fury of the blow-off is directed through the opening, where it does not harm anything. That there is no violent pressure in the bay has been proven by the fact that the packings last so long. The upper packing is stationary. Opening or closing of valve does not alter compression on either packing. No leakage, open or shut.

We make nothing but valves, but we make all sizes, for any pressure, for every purpose—Gates, Globes, Angles, Checks and Blow-offs. High grade valves exclusively. No competition stuff whatever.



Guaranteed

When closed the pressure is against plunger here—can't hurt it in a hundred years

Steel lever wrench to compress sleeve 10 on packing 9

Steel bolted gland for upper packing 13

Nelson Valve Company

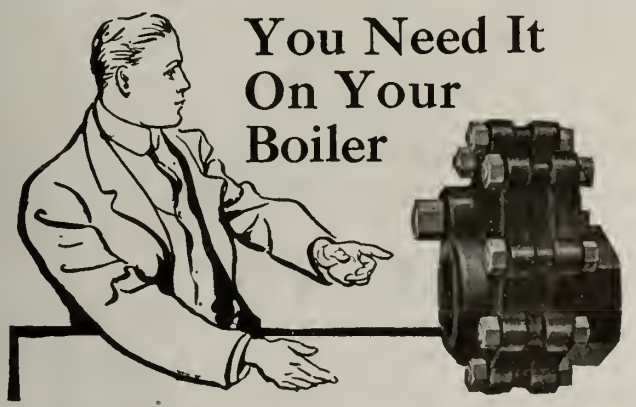
Philadelphia

New York	30 Church Street
Chicago	17 W. Kinzie Street
Pittsburgh	317 Liberty Avenue
Minneapolis	622 Andrus Building
Butte, Mont.	56 E. Broadway
San Francisco	22 Battery Street
Montreal	12-14 University Street

BY MAKING GOOD

The "EVERLASTING" BLOW-OFF VALVE

has made a name for itself. It can live up to its reputation, and can save you time and worry. You have a good boiler, why not put the best accessories on it.



You Need It On Your Boiler

Here is Another

THE "FLEXIBLE" TUBE CLEANER

IT CUTS

SAVES HALF THE LABOR and

CLEANS THE TUBES

Engineering Specialties Company

1080 King Street West

TORONTO, ONTARIO

H. L. PEILER & CO., 380 St. James Street, Montreal

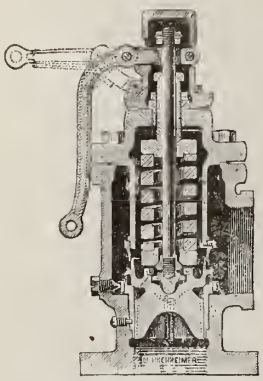
AGENTS:

THE A. R. WILLIAMS MACH. CO. OF ST. JOHN, N.B., LTD., St. John, N.B.

P. D. McLAREN, LIMITED, Calgary, Alta.

The advertiser would like to know where you saw his advertisement—tell him.

LUNKENHEIMER POP SAFETY VALVES



Iron Body, Brass Mounted, Incased Spring.

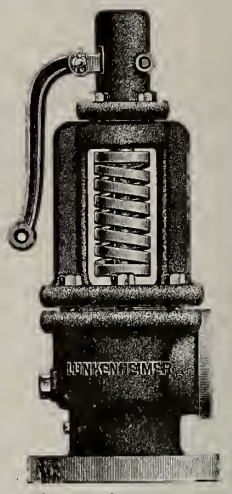
These valves are economical because they will relieve only enough steam to reduce excessive pressures. They can be positively relied upon to operate promptly and will not chatter or pound themselves to pieces.

They can be regulated to reduce the pressure only one pound, if such close regulation should be desired, and adjustment of the pop and pressure can be made from the outside of the valve.

All parts subjected to wear are renewable. Either Brass or Iron Valves can be had, with incased spring or spring exposed.

For durability and reliability, LUNKENHEIMER POP VALVES have no equal.

Specify and insist upon securing genuine **Lunkenheimer make.** Do not accept substitutes—they are never good as the genuine.



Iron Body, Brass Mounted, Outside Spring.

"MOST supply houses sell them—yours CAN—if they DONT or WONT tell US."

Write for 1912 Catalogue.

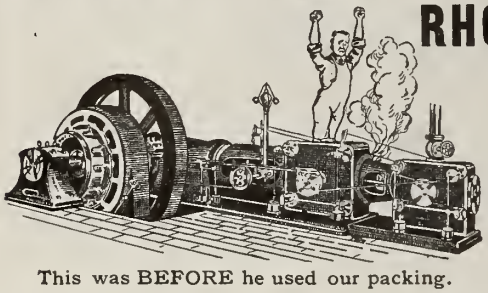
THE LUNKENHEIMER COMPANY

Largest Manufacturers of high-grade Engineering Specialties in the World.

General Offices and Works: - - - - - - CINCINNATI, OHIO, U.S.A.

4 CHICAGO, 186 North Dearborn Street — NEW YORK, 64-68 Fulton Street — BOSTON, 138 High Street — LONDON, S.E., 35 Great Dover Street

RHODES IMPROVED METALLIC PACKING

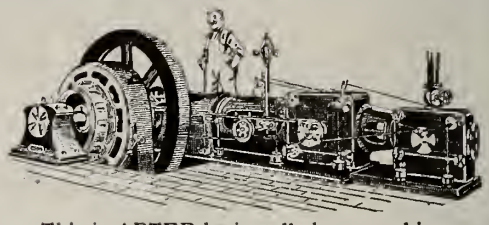


This was BEFORE he used our packing.

THE PACKING THAT PACKS

A trial will convince you.

Beware of Imitations.



This is AFTER he installed our packing.

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited

55 St. Francois Xavier Street, - - - MONTREAL

Self-Lubricating

In Cans 6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

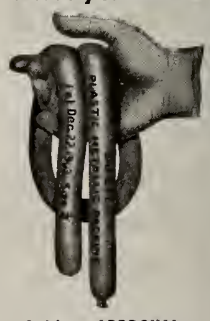
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

Practically Frictionless



Sold on APPROVAL

The advertiser would like to know where you saw his advertisement—tell him.

We'll Stand the Cost of J-M Permanite Sheet Packing if it Doesn't "Make Good"

We have so much faith in J-M Permanite Packing that we are willing to accept your order and let you test it entirely at our risk.

We put it up to the packing. And you are to be the judge as to whether or not it makes good,

Try it on your most troublesome joints—joints which heretofore, with other packings, have needed constant attention.

If J-M Permanite Packing doesn't put an end to the troubles these joints have been giving—if it doesn't make them permanently leakproof—if it doesn't eliminate the need for following up—then return what you have left and we'll refund the full amount of your bill. *The trial won't cost you a cent.*

Surely it's well worth your while to find out—under the protection of our money back offer—whether J-M Permanite Packing will put an end to those leaky joints and all the vexations and delays they cause.

Send our nearest Branch your order now with the above understanding stating the conditions you have to overcome and the size of Packing desired. We're making you a straightforward offer on which YOU have nothing to lose. WE take all the risk.

THE CANADIAN H. W. JOHNS-MANVILLE CO., Limited

Manufacturers of Asbestos and Magnesia Products

TRADE ASBESTOS MARK

Asbestos Roofings, Packings, Electrical Supplies, Etc.

TORONTO, ONT. MONTREAL, QUE. WINNIPEG, MAN. VANCOUVER, B.C.

1331

The ASBESTOS & RUBBER GOODS CO.

TORONTO, Ont.
141 King Street East,

MONTREAL, Que.
43 St. Francois Xavier Street,

L. R. & B. PUMP VALVES

Give better service than any other, and last longer

Brass Casing prevents ports from forcing through.

Only best quality of material is used, and as wear takes place the rubber can be replaced until brass casing is reached, thereby giving full use of all the rubber.

It only needs a trial to convince you.

We also carry a full stock of all other engineers' supplies.

Write us before placing your orders.

The advertiser would like to know where you saw his advertisement—tell him.

Dearborn Treatment of Boiler Feed Waters

positively eliminates all scale formation or corrosion in boiler tubes or on the sheets. It is the only scientifically certain method whereby fuel consumption may be reduced to the minimum, and whereby substantial savings in the power cost of any plant may be obtained.

No matter what the type or size of your boiler may be, Dearborn Treatment of your feed water will give you increased steaming capacity and effect important economies, as we shall be glad to demonstrate to your satisfaction.

Send us the jug to-day. We will make the analysis and suggest the proper treatment free of charge. We offer this service to every power user.

Dearborn Drug & Chemical Works

General Offices, Laboratories and Works, Chicago

General Eastern Offices—299 Broadway, New York. Buffalo Office—302 Morgan Building, J. N. Gregory, Mgr.

Would you like to Spend your Sundays at Home?

Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

YOU can reduce the labor and expense of boiler cleaning and cut down your consumption of fuel by using

McCOLL'S Special Boiler Compounds

or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

WRITE FOR PARTICULARS TO

McCOLL BROS. & COMPANY

Montreal, Toronto, Winnipeg or Vancouver

Make Use of Your Exhaust Steam—It's Valuable!

YOU can save much fuel by harnessing your exhaust steam and making it heat your Feed Water to a boiling point before it enters the boiler. The

"NATIONAL" FEED-WATER HEATER

is the result of hard study and **long experience.** It is so constructed that the Feed Water never comes in contact with the shell, and at no time is the shell subject to boiler pressure; consequently corrosion or leakages are impossible.

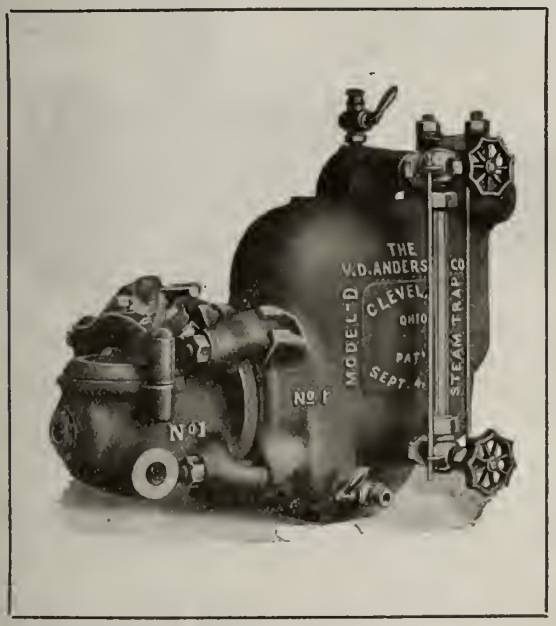
Coils of seamless drawn brass or copper tubing, in a shell of cast iron or steel, carry the Feed Water; exhaust steam admitted to the shell heats the water in the tubes.

Write Us at once for Catalogue and further Information.

The National Pipe Bending Company

91 Lloyd Street, New Haven, Conn., U.S.A.

The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

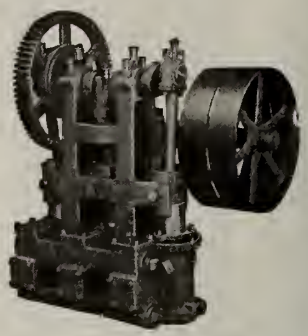
Deming Power Pumps

Made in Many Sizes

For all Pumping Conditions

Automatic Sprinkler System Pumps.
Boiler Feed Pumps.
Combination Water and Air Pumps.
Deep Well Working Heads.
Electric Driven Triplex Pumps.
Gas Engine Driven Pumps.
Paper Makers' Pumps.
Railway Water Supply Pumps.
Tank Pumps for light, medium or heavy service.
Waterworks Pumps.

and including many others. The entire line is shown in our catalogue "H."



Deming General Service Triplex Power Pump for operation by belt. Requires but little power for operation.

The Deming Company

SALEM - - - OHIO, U.S.A.

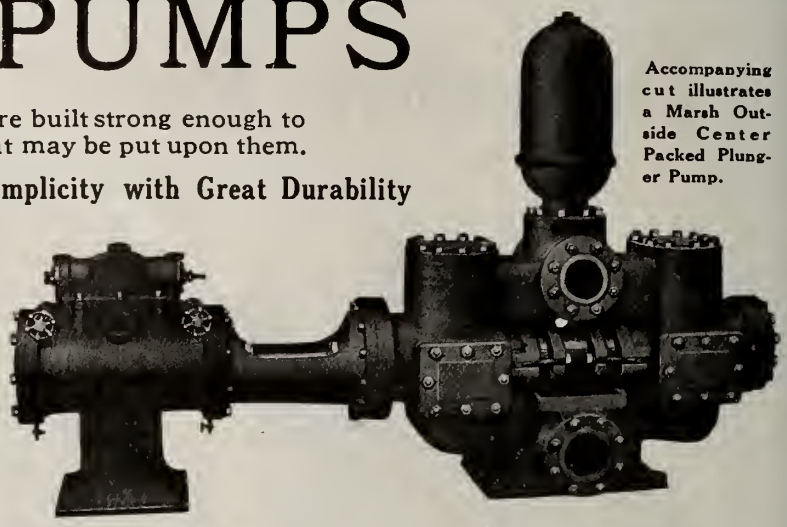
HAND AND POWER PUMPS OF ALL KINDS.

Agencies—Henion & Hubbell, Chicago, Ill.; Darling Bros., Montreal, P.Q., Can.; Morgan Engineering Co., Seattle, Wash.; Root, Neal Co., Buffalo, N.Y.

MARSH PUMPS

Are the heavy, massive kind, that are built strong enough to withstand any unforeseen strain that may be put upon them.

They Combine Efficiency and Extreme Simplicity with Great Durability



Accompanying cut illustrates a Marsh Outside Center Packed Plunger Pump.

TAKE the pump shown here, for instance, note the massive construction, note the absence of outside moving parts on the steam end and the general simplicity in construction throughout. The Marsh Pumps are not cheap in any sense of the word. They are built for long, continuous service and every pump is absolutely guaranteed for the service on which it is recommended. We stand back of all our material and workmanship for one year.

Our new No. 18 general catalog illustrates and describes the different types of Marsh and American Pumps. Write to-day for your copy. It is a treatise and reference book every engineer and power plant superintendent should possess. It is free on request.

CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Hallman & Peniston Machinery Co., Vancouver, B.C
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancey & Grindley, Limited.
Edmonton and Calgary.

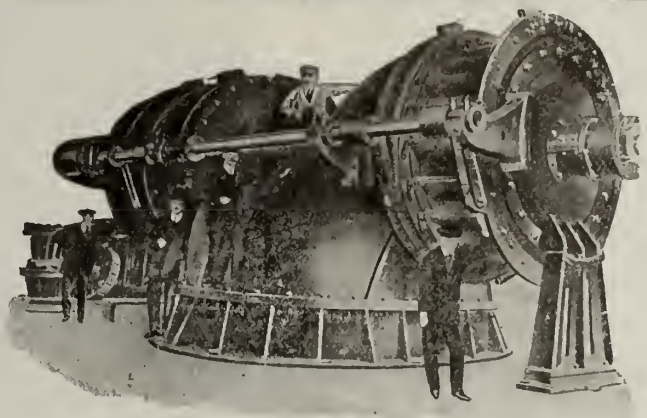
AMERICAN STEAM PUMP COMPANY

Battle Creek, Mich.

WATER TURBINES
—AND—
GOVERNORS

All Sizes

Maximum Efficiency



All Heads

Ideal Control

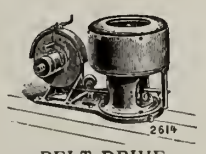
ASK FOR PARTICULARS FROM

THE CANADIAN BOVING CO., LTD.

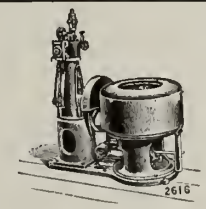
164 BAY STREET, TORONTO.

Branch Office for British Columbia, 427 Seymour St., Vancouver

BELT DRIVE

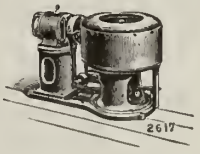


BELT DRIVE



ENGINE DRIVE

WATER DRIVE



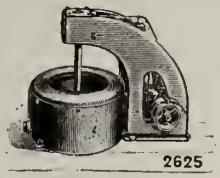
ELECTRIC DRIVE

ELECTRIC DRIVE

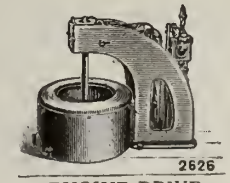
HYDRO-EXTRACTORS

To Meet All Requirements

BELT DRIVE

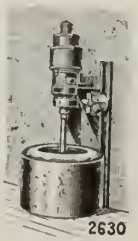


BELT DRIVE



ENGINE DRIVE

ELECTRIC DRIVE



ELECTRIC DRIVE

WATER DRIVE

WATSON, LAIDLAW & CO., LTD.

98 DUNDAS STREET (South), GLASGOW

For further particulars, apply to:—

JONES and GLASSCO, St. Nicholas Building, Montreal.

The advertiser would like to know where you saw his advertisement—tell him.

CONVERTED

THE foundation upon which we have built a world-wide business is based upon our policy of seeking and curing troublesome bearings, and otherwise demonstrating the value and economy of Magnolia Metal. Magnolia is not a **SOFT** metal; its factor of safety is far in excess of the requirements of any properly-constructed bearing—and outwears even brass or bronze, giving much better service.

There is a lot of misinformation regarding "hard" bearings.

No matter how hard they are, they go to pieces or give trouble when they get hot—which they generally do.

Magnolia keeps cool, won't squash, stays put, and won't cut.

O. B. LITTELL, 622 Pontius Avenue, Seattle, Wash.

December 7th, 1911

GENTLEMEN—I take pleasure in stating that I am a user of Magnolia Metal and have been for the past two years.

I have put Magnolia Metal to what I consider a thorough trial. The first place I applied the metal was to an emery wheel travelling 1200 R.P.M., and it worked so well that I then applied it to a fan 1470 R.P.M. The next place was to the crank pin of my main engine, and having such good results I concluded to babbitt the cross head brasses. In all the places the metal was applied, not one bearing has been taken up over 1/16 in. and has run from 12 to 18 months.

I have come to the conclusion that Magnolia is surely a riddle; it can be worked like lead and still be as tough as it is.

I was somewhat afraid to try it in my main engine, because I thought it was too soft to stand up to the work, but I have a different opinion now. I have been following this line of work for over 12 years and am sorry that I did not have an introduction sooner.

Yours respectfully, ALLEN J. STOCKE,
Engineer in Charge.

SPECIAL OFFER.

PRACTICAL ENGINEER POCKET BOOK: 680 pages, over 2000 subjects. Price 40c. postpaid. We do not aim to make a profit on these books. We buy them in large quantities as an advertising medium and give Engineers the benefit of low price. They are highly spoken of by Engineers. **Address Montreal Office.**

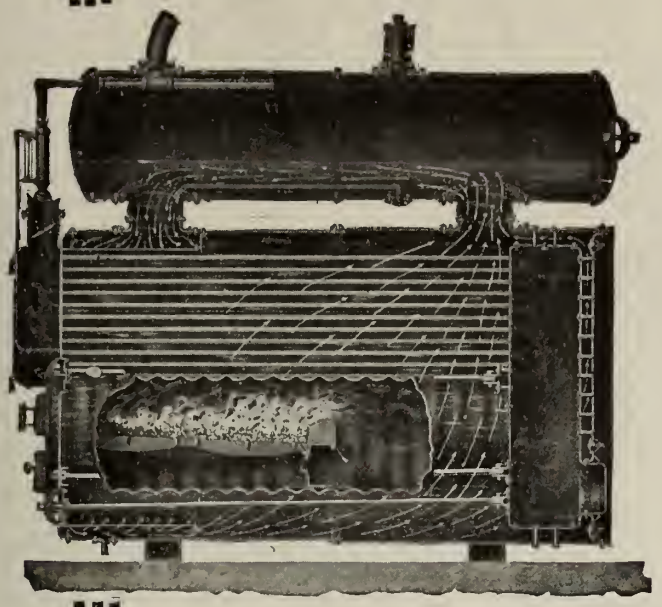
Sold by leading dealers everywhere or by

Magnolia Metal Co.

225 St. Ambroise Street, Montreal

New York Chicago

JUST What You've Been Looking For



An Internally Fired Boiler with Rapid Circulation

Not a Pump or Other Device

ROBB-BRADY SCOTCH BOILER

THE STANDARD SCOTCH MARINE BOILER MODIFIED FOR PLANTS ASHORE

This new type solves the circulation problem. The water beneath the furnaces is constantly compelled to flow upwards to the rear by the downflowing feed water which comes through the front neck, as shown.

The Robb-Brady boiler has a cylindrical combustion chamber—engineers know what that means—no flat top, no crown bar or girder stays.

The large body of water in steam drum, neck and shell maintains practically the same temperature throughout the boiler, preventing unequal expansion.

The shell plates are thinner than in the standard Scotch boiler because the shells are of smaller diameter.

Ask for Bulletin No. 3.

ROBB ENGINEERING COMPANY, Limited

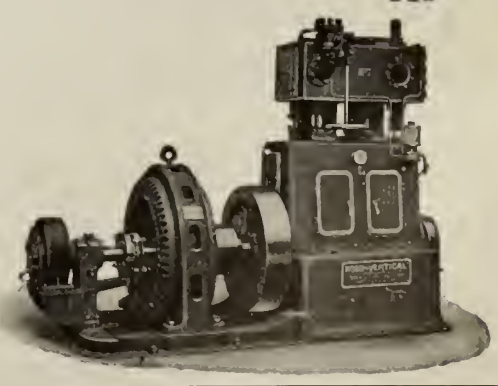
AMHERST, N. S., CANADA. SOUTH FRAMINGHAM, MASS.

39-13

SOLE CANADIAN AGENTS FOR
C. A. PARSONS & COMPANY, Newcastle-on-Tyne.
Turbines and Turbo Pumps, Blowers and Compressors.

DISTRICT OFFICES:
Canadian Express Bldg., Montreal, R. W. Robb, Manager
Traders Bank Bldg., Toronto, Wm. McKay - "
Union Bank Bldg., Winnipeg, Wm. F. Porter, "
Grain Exchange Bldg., Calgary, J. F. Porter - "

MANUFACTURERS OF
Vertical Enclosed Compound Engines. Horizontal Return Tube Boilers. Vertical Boilers. Water Tube Boilers. Robb-Mumford Internally Fired Boilers. Macdonald Shaking Grates.



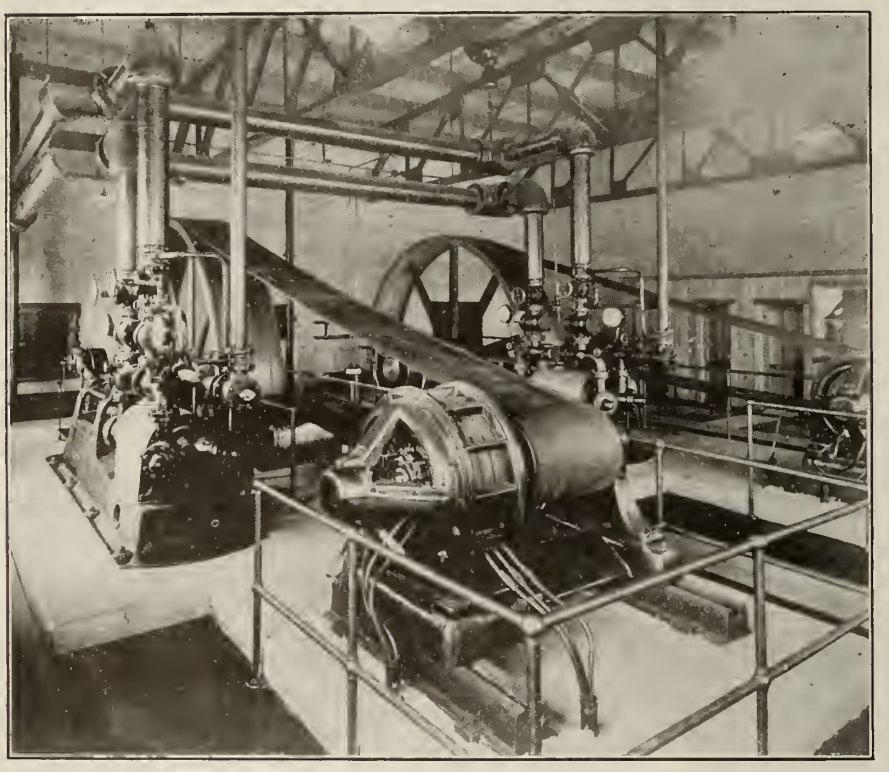
The advertiser would like to know where you saw his advertisement—tell him.

"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton " Linde " Belt Driven, Double Acting, Horizontal Ammonia Compressors Manufactured and Installed by us in Canada.

Recent Orders:—

HOTEL CHATEAU LAURIER, Ottawa, Ont.
DOMINION EXPRESS BLDG., Montreal, Que.
MONTREAL GENERAL HOSPITAL, Montreal.
DOMINION DAIRY & PRODUCE CO. Regina, Sask.
DALE ESTATE, Brampton, Ont.
DUMART BROS., Berlin, Ont.
CANADA CEMENT, Venezula, So. A.
CARLYLE DAIRY CO., Calgary.
COSGRAVE BREWING CO., Ltd., Toronto, Ont.
HOLT, RENFREW CO., Toronto, Ont.
UNITED FRUIT CO., Costa Rica.

AND MANY OTHERS.

The Linde Canadian Refrigeration Co., Limited

37 ST. PETER STREET, MONTREAL.

BRANCH OFFICES—Toronto, Imperial Building, Adelaide St.; Winnipeg, 909½ Main Street; Vancouver, Imperial Block, Seymour and Pender Streets; Edmonton, 562 Second Street.

The advertiser would like to know where you saw his advertisement—tell him.

THE LINDE BRITISH REFRIGERATION CO., LIMITED

ESTABLISHED 26 YEARS.

HEAD OFFICE, 35 Queen Victoria St., London, E.C.

DIRECTORS :

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C. Von LANG PUCHOFF,
K. S. MURRAY,
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G. H. LLOYD, Chairman,
T. B. LIGHTFOOT,
Managing Director

TRADE **LINDE** MARK

BRANCHES:

CALCUTTA
SYDNEY, N. S. W.
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MONTREAL.

OVER **8000** MACHINES SOLD

for every purpose requiring

MECHANICAL REFRIGERATION

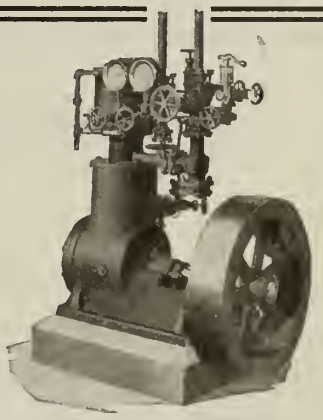
628-9 CORISTINE BUILDING, MONTREAL, P. Q.

ESTABLISHED 1867

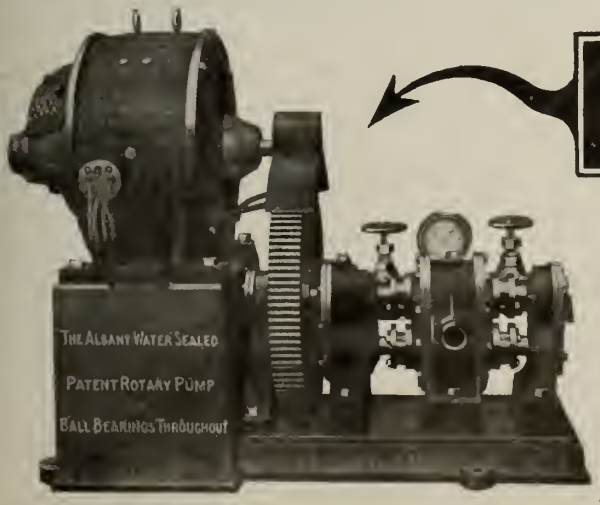
THE VILTER MANUFACTURING CO.

242 BECHER ST., MILWAUKEE, WIS., U.S.A.

A small machine for small Ice-making and Refrigerating Plants, as well constructed and as successful in operation as larger outfits. VERTICAL SINGLE ACTING AMMONIA COMPRESSORS, different sizes. Built with fewest possible number of parts. Sold at low price. Excels all others of like size in every point—simplicity, efficiency, reliability, smoothness of action, etc. We build horizontal and vertical ICE-MAKING AND REFRIGERATING MACHINERY, a full line of CORLISS ENGINES, and MACHINERY FOR BREWERS AND BOTTLERS. Our plant covers more than eight acres of ground.



Vertical Single-Acting Ammonia Compressor, Enclosed Type for Belt-drive



The "ALBANY" Water Sealed ROTARY PUMP

(Patented in all Countries)

This is an absolute force pump that cannot get out of order.

NO VALVES—ONLY TWO WORKING PARTS

It is positive and delivers a full stream.
Made in all sizes from 300 to 60,000 gallons per hour.
Supplied for Belt or any other drive.
Better investigate the Albany Pump. There are hundreds of satisfied users in Canada who will testify as to its efficiency.

Write for descriptive circulars.

CANADIAN DISTRIBUTOR:

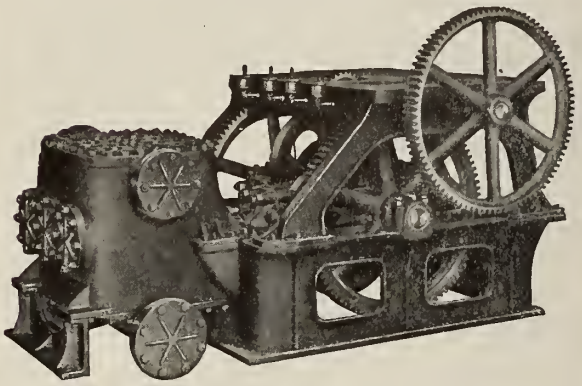
A. W. BENNET, 206 KING ST. WEST, TORONTO, ONT.

The Luitwieler Double Acting

Triplex Power Pump

Non-Pulsating No Vibration

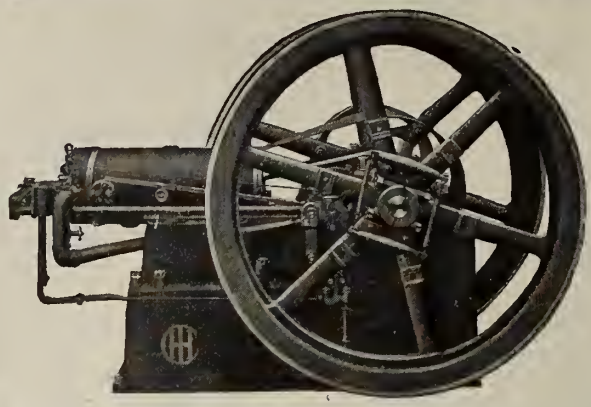
Highest Efficiency



Send for Catalogue

The General Machinery Co., Limited

527 Traders Bank Building - Toronto, Ont.



I H C ENGINES FURNISH AMPLE POWER AT LOWEST COST

In an emergency, an I H C engine will develop from 15 to 30 per cent. more power than it is sold for. Because of its scientifically correct mixer, it uses less gasoline to develop that power than is required by any engine not so equipped. It is durable because only the best material is used, put together with the precision of a high-priced watch. For work on farm or estate, in mill, shop, or factory, wherever reliable, dependable power is required, an I H C engine is the one best buy.

I H C engines are made in every style—horizontal and vertical, air and water-cooled, stationary, portable and mounted on skids, to operate on gasoline, kerosene, distillate, or alcohol; sizes 1 to 50-horse power; kerosene-gasoline tractors, 12 to 45-horse power. A post card will bring you a catalogue full of practical, useful information.

International Harvester Company of America
(INCORPORATED)

50 HARVESTER BUILDING, CHICAGO U S A

The POPULARITY of IMPERIAL ENGINES still increases.

Maximum Efficiency

Minimum Fuel Consumption

Imperial Works.

Invented and Manufactured by the

KEIGHLEY GAS & OIL ENGINE CO.,
LIMITED

KEIGHLEY, - - ENGLAND.

Sole Selling Agents in CANADA

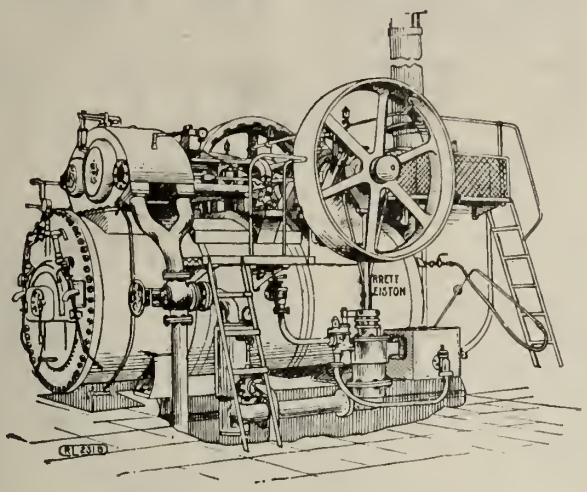
H. W. PETRIE, Ltd.
Machinery Experts,

TORONTO, - - ONTARIO.

FULL DETAILS ON APPLICATION.

The advertiser would like to know where you saw his advertisement—tell him.

1.19 lbs. of COAL per B.H.P. Hr.



A Garrett Patent Superheated Semi-Stationary Engine has no pipe lines nor cylinder condensation losses. Note the remarkable results of this independent seven-hour test made on a stock machine.

Superheat	536.5 ° F.
I. H. P.	58.25
B.H.P.	55.6
Mech. Eff.	95.5%
Water evap. per lb. of coal	8.91 lbs.
Coal (per B.H.P. Hr.)	1.19 "
Water " "	10.66

Cut this Coupon out ***NOW.*** It will bring our most interesting booklet on the most efficient engine made. Used for every purpose.

Send me circulars re your Semi-Stationary Engine.

NAME.....

STREET.....

CITY.....

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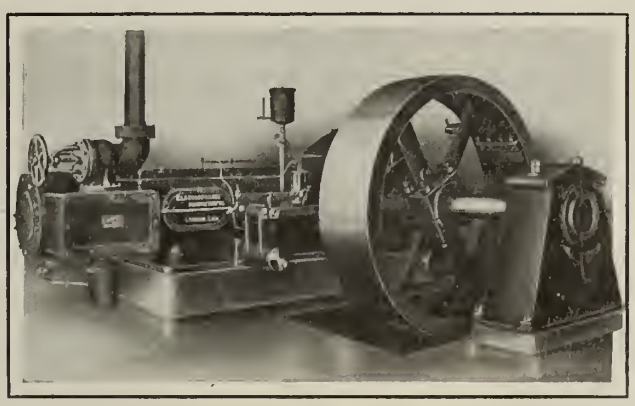

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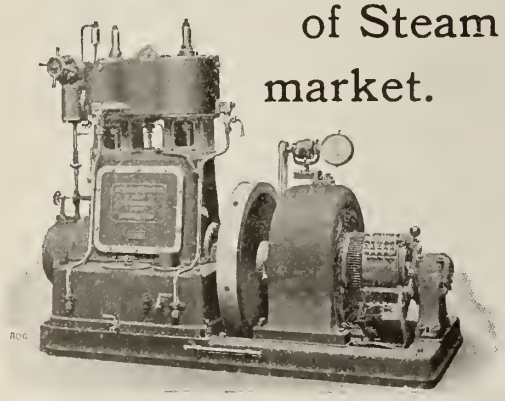

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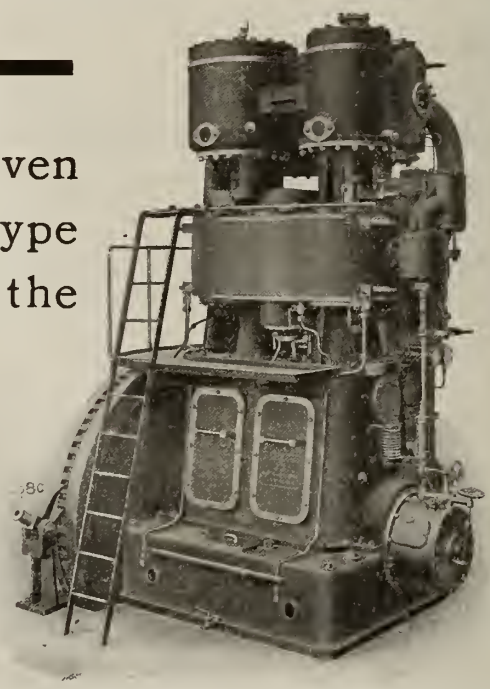

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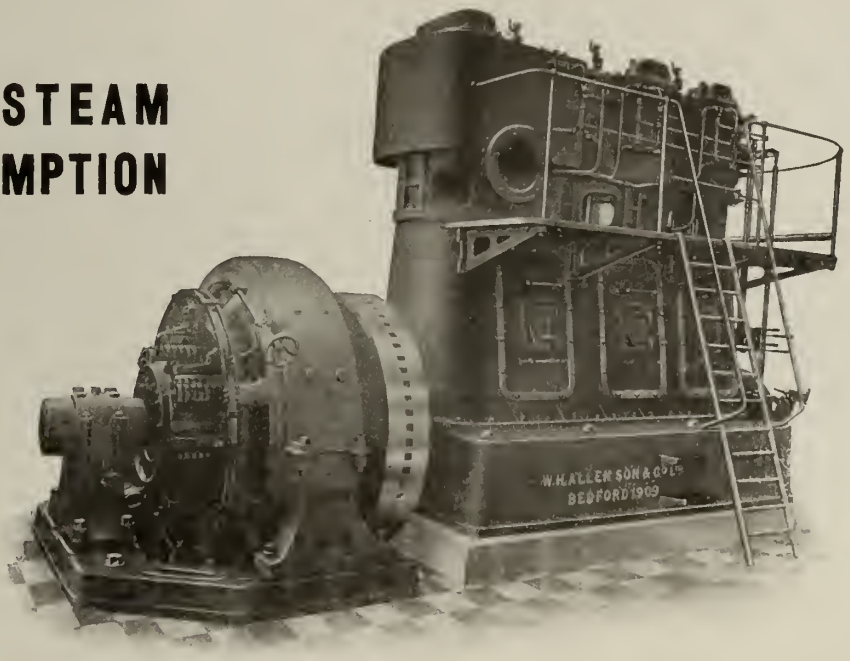

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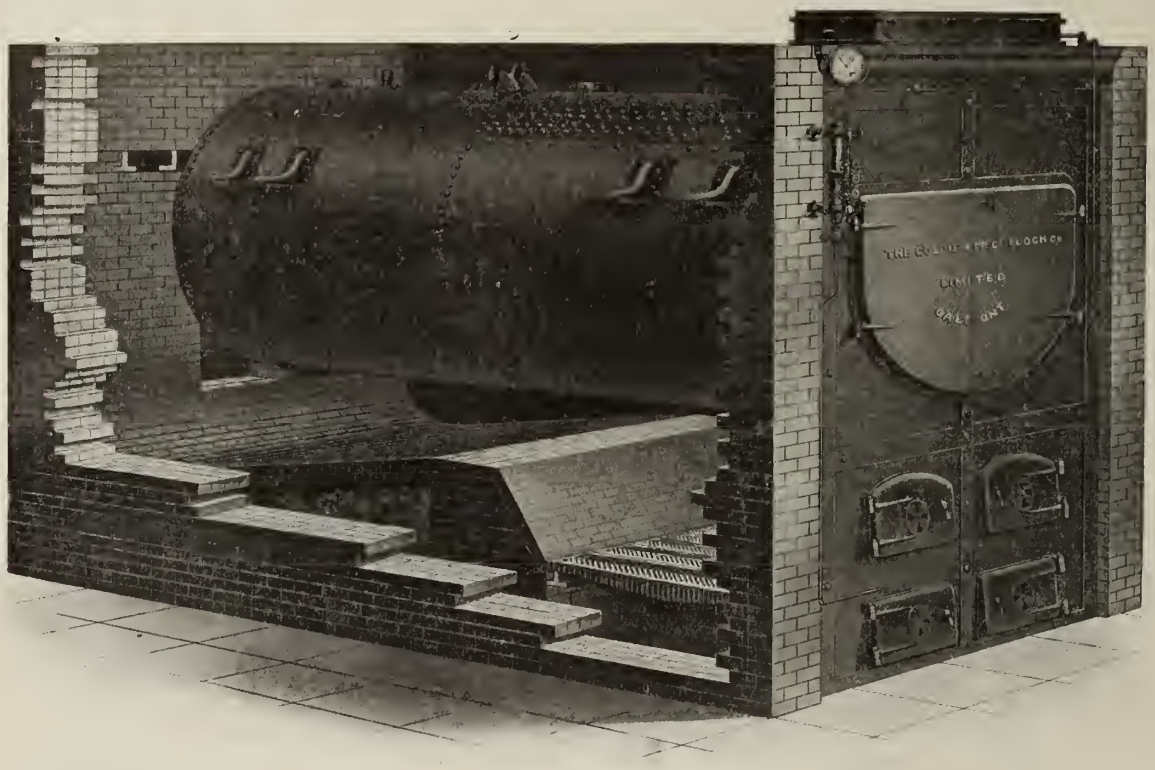

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FIG. 1 — THE HEART OF OTTAWA, SHOWING THE PARLIAMENT BUILDINGS, THE CHATEAU LAURIER, THE G.T.R. CENTRAL DEPOT, THE RIDEAU LOCKS AND CANAL, ETC.

Power Plant at New Grand Trunk Railway Depot, Ottawa

By Halyard

That a due appreciation of the value of a thoroughly modern and well equipped power plant at their leading terminals and rolling stock repair centres by the management of our great railroad corporations is being developed and put into practical effect, there is ample evidence to be found in the details and illustrations which form the substance of this article.

THE erection of a handsome central passenger depot and a palatial hotel as a necessary adjunct explains at once the reason for the existence, today, of the power plant here described. An outstanding feature of the whole scheme and worthy of special notice by the reader, is the fact that the housing of the equipment has not been relegated to the basement of either the hotel or the depot, but is honored by a distinct and separate building, above ground, well lighted by ample window provision, and of lofty proportions conducive to thorough ventilation. Hotel guests, perhaps as much as anyone, will appreciate this isolation from the numerous annoyances inseparable from a basement plant, while at the same time deriving all the comfort and conveniences obtainable. The lot of the operators under the arrangement adopted is also much improved comparatively, and will, we are inclined to believe, be found not the least valuable aspect of the location.

Fig. 1, in which are to be seen the Parliament Buildings, the post office, the Rideau locks and canal, furnishes also a highly expressive conception of the architectural style, proportions and extent of the Chateau Laurier, the Plaza Laurier and the Grand Trunk Central Depot. The power house is not included in this illustration, its relative position being more or less a continuation of the wall face of the depot here shown, and in the direction of the platform at which the train, seen in the picture, is arriving.

Boilers, Stokers, Coal and Ash Handling Machinery.

The boiler room forms what may be termed the lower end of the power house building, and is in consequence further removed from the depot and chateau. Its equipment consists of four 300 H.P. vertical water tube boilers, built by Wickes Bros., Saginaw, Mich., for a working steam pressure of 160 pounds per sq. inch. Each boiler is fitted with Green chain grate stokers, by the Green Engineering Co., Chicago., having a unit grate area of 56 square feet. Two 5 by 5 inch vertical steam engines, either of which takes care of the operation of the stokers, completes this installation feature, of which Fig. 2 shows a general view and Fig. 3 an individual equipment in more full detail.

The fuel handling apparatus, capable of dealing with 30 tons of coal per hour, consists of a short headed flight conveyor which carries the coal to a double roll crusher from the hopper, underneath the coal car track. The conveyor and crusher are operated by 25 H.P. 220 volt motors. An elevator takes the coal to a scraper conveyor, which distributes it to the bunkers; the motive power being supplied by 15 H.P. 220 volt D.C. motors. The ashes are taken care of by means of a spiral conveyor. This carries them to the coal elevator from which they are delivered to an ash bunker, whose capacity is 4 carloads. A by-pass valve in the elevator head permits of handling both coal and ash in the same elevator. The spiral conveyor is operated by a 7 H.P. motor. All of the coal and ash handling machinery was supplied by the Jeffrey Mfg. Co., Columbus, Ohio.

Boiler Room Piping and Fittings.

Long radius extra heavy, 6 inch steel pipe bends lead to a 10 inch steam header located behind the boilers, and this latter is fitted with a gate valve at its centre in order that sectional repairs may be undertaken if necessary. The

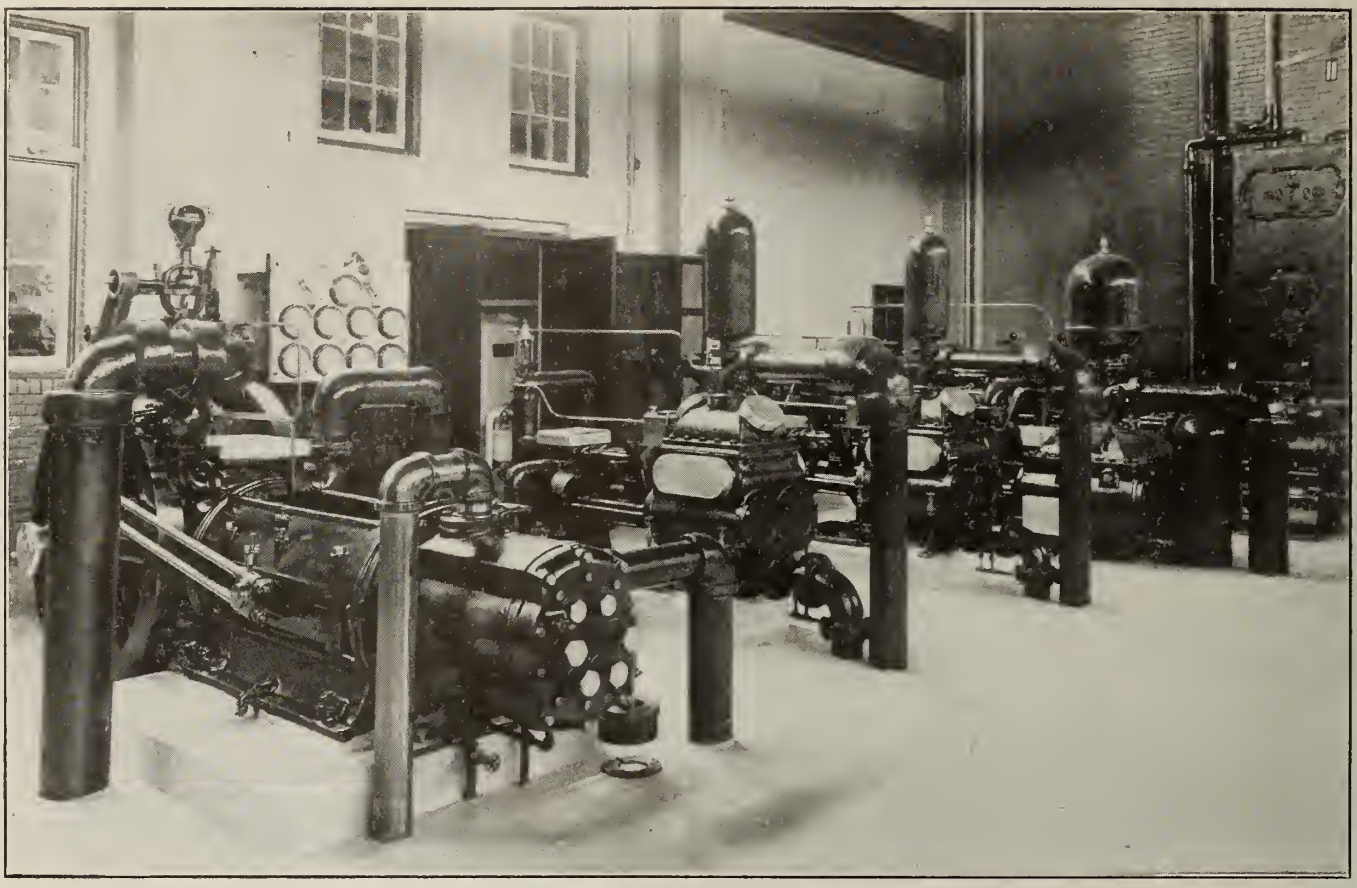


FIG. 2 — GENERAL VIEW OF BOILER ROOM, SHOWING STOKERS, ETC.

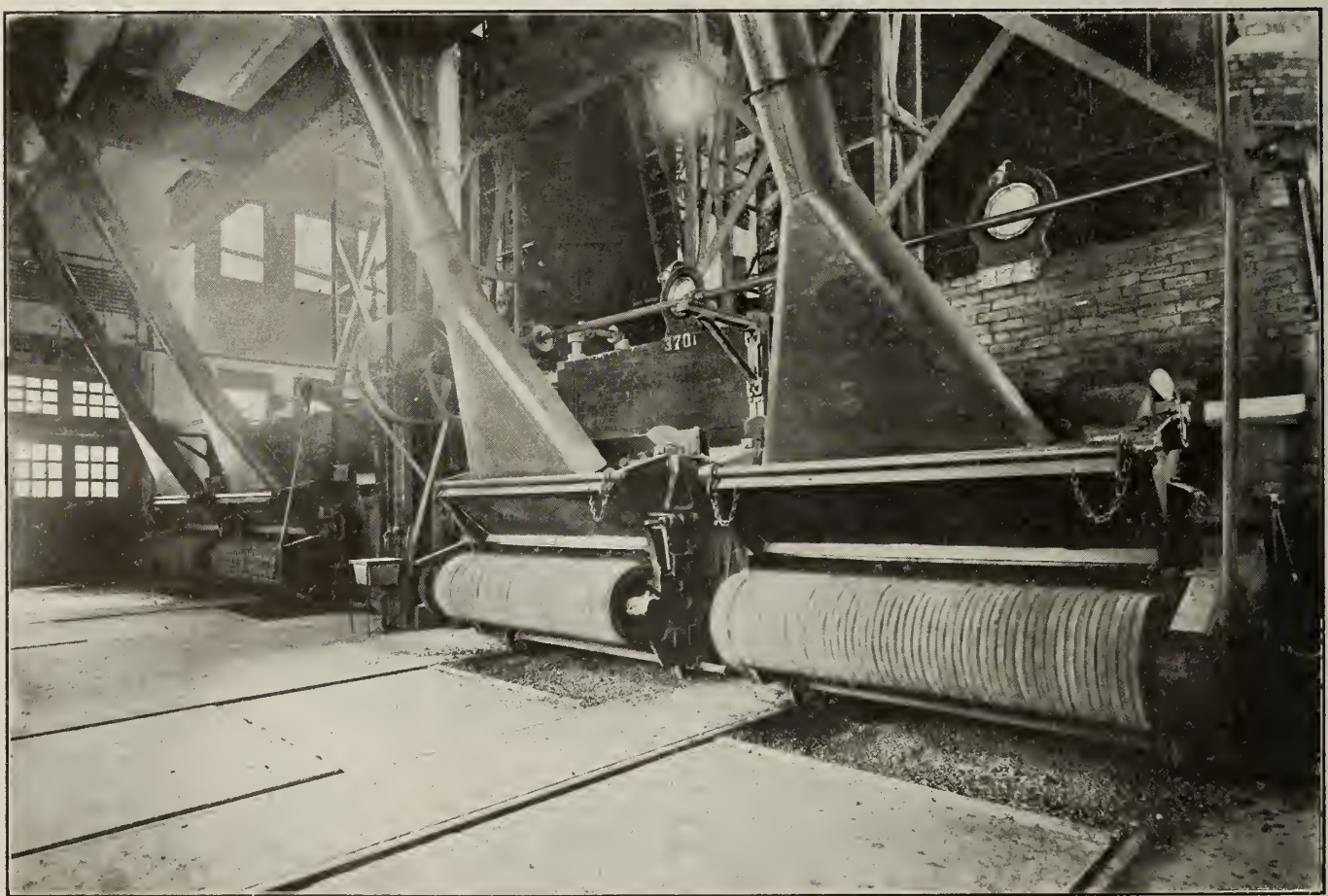


FIG. 6 — CORNER IN ENGINE ROOM, SHOWING AIR COMPRESSOR, UNDERWRITER FIRE PUMP BOILER FEED PUMPS ETC.

feed water piping, of 4 inch extra heavy brass, with cast brass fittings, is arranged in a double line, with provision made whereby a section may be taken out of service for repairs, without interruption to the boiler feed. Each boiler is fitted with a Wright high and low water alarm column, two 3½ inch Crane pop safety valves, a 6-inch angle stop and check valve, a 6-inch rising spindle gate valve for main steam connection, a 50 A. Hancock inspirator as an auxiliary feed, and an "Everlasting" and angle pattern blow-off valve combination set. The water blown from the boilers passes into a blow-off tank, and from there to the sewer. A brickwork breeching built behind the boilers carries the gases to a steel-concrete chimney, 150 feet high. This latter provides a powerful draught for the furnaces; slack coal being the fuel used.

Engine Room—Power Units.

The power generation units in the engine room consist of 4 Goldie & McCulloch Ideal tandem-compound high speed engines, with cylinders 14 and 24 inches diameter by 16 inches stroke, running 225 R.P.M., and direct-connected to Can.-Westinghouse 175 K.W. 250-125 volt, D.C. generators. Two of these units take care of the day load, while three of them are ample to carry the peak load in the early part of the night. The 3 wire system has been adopted; the higher voltage being used for the motors, elevators, etc., while the lower voltage is used for the lighting service.

The switchboard, of blue Vermont marble, is made up of nine panels, four of which are for the main generators, one for the voltimeter, ammeter, and hour wattmeter, and one each for the Chateau power, Chateau lighting, Central Depot power and Central Depot lighting. In addition to the foregoing, there are five wall panels for service in connection with power and lights in the plant. The switchboard and panels with their equipment were supplied by the Can.-Westinghouse Co.

Pump and Air Compressor Equipment.

The basement of the engine room is provided with a sump into which the oil separators and traps discharge. On account of this sump being below sewer level, a small vertical centrifugal pump, supplied by the Smart-Turner Co., Hamilton, direct connected to a 1¼ H.P. Westinghouse D.C. motor and automatically controlled by a float, takes care of the excess accumulation of water.

Two duplex, outside end packed, 10-6-10 inches Worthington boiler feed pumps, either of which is capable of maintaining the full service, and supplied by the John McDougall, Caledonian Ironworks Co., Montreal, take the feed water from an 1800 H.P. Cochrane open heater at temperatures ranging from 212 to 220 degrees, according to back pressure of exhaust and discharge same to boilers through the already-mentioned 4-inch extra heavy brass feed main connections. Each pump is equipped with a 2-inch Waters pump governor, and a Murray feed water regulator controls the boiler supply.

For fire protection purposes, an Underwriter fire pump, size 16-9-12 inches, fitted with a Fisher pump governor, maintains a pressure of 130 pounds per square inch on the fire hose lines of the Chateau, the Central Depot and the power house. This pump takes water from the city mains at pressures varying from 45 to 50 pounds per square inch. Two 8-6-12 inches duplex piston packed pumps are installed for the

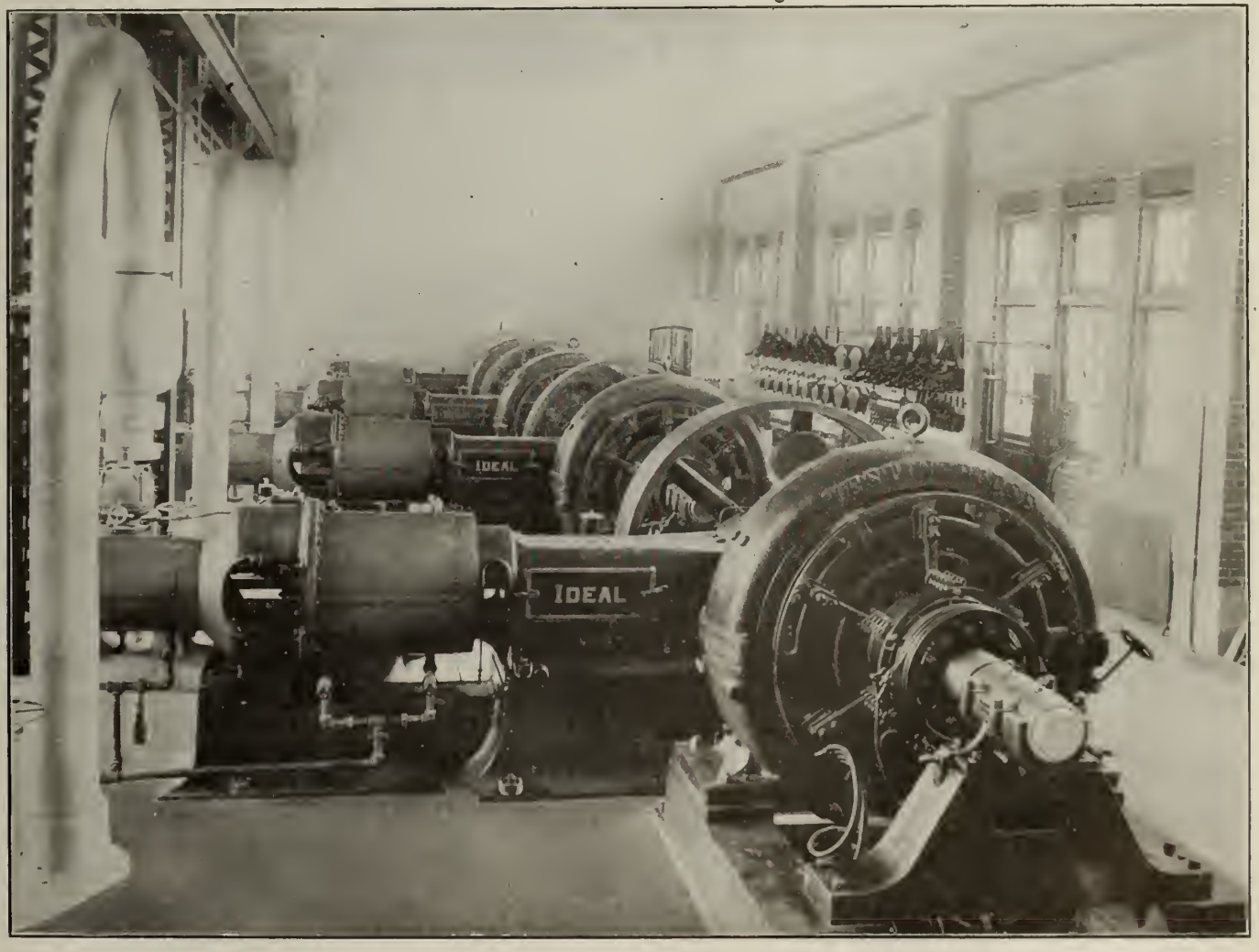


Fig. 4 — One side of Engine Room, showing Goldie & McCulloch Engines, Can-Westinghouse Generators and Switchboard.

water supply to the Chateau and Central Depot, and maintain a pressure of 85 pounds per square inch. The Canada Foundry Co., Toronto, supplied the Underwriter fire pump, as well as the two above-mentioned water service pumps.

Compressed air, in addition to being used in the power house in pneumatic tools, does service in the train shed adjoining for airbrake testing, car cleaning, etc., and to provide this commodity, a Canadian-Rand Class C air compressor with capacity of 250 cubic feet of free air per minute, has been installed.

Refrigeration and .Water Sterilizer Equipment.

For refrigeration purposes, two 20-ton Linde-Canadian ammonia compressors, 9 by 18 inch cylinder, driven by Goldie & McCulloch, 13 by 18 inch cylinder Wheelock engines running 90 R.P.M. are installed. Two duplex piston packed brine pumps, 8-6-12 inches, pump brine to the Chateau and Central Depot refrigerator boxes. Each pump is capable of delivering 200 gallons per minute, which is equal to the full requirement, therefore, one unit forms a reserve. Delivery is made at a temperature of 10 degrees above zero; the supply and return mains being 4 inches diameter and well insulated with 3 inch cork covering.

All the water used in the Chateau and Central Depot is filtered and afterwards sterilized. The filters, 3 in number, having each a capacity of 3,000 gallons per minute, were manufactured by the Roberts Co., Philadelphia. The sterilizing plant was supplied by the J. F. Forbes Co., also of Philadelphia. A suction tank of 2,000 gallons capacity, connected with the service pumps, receives the water from the sterilizer.

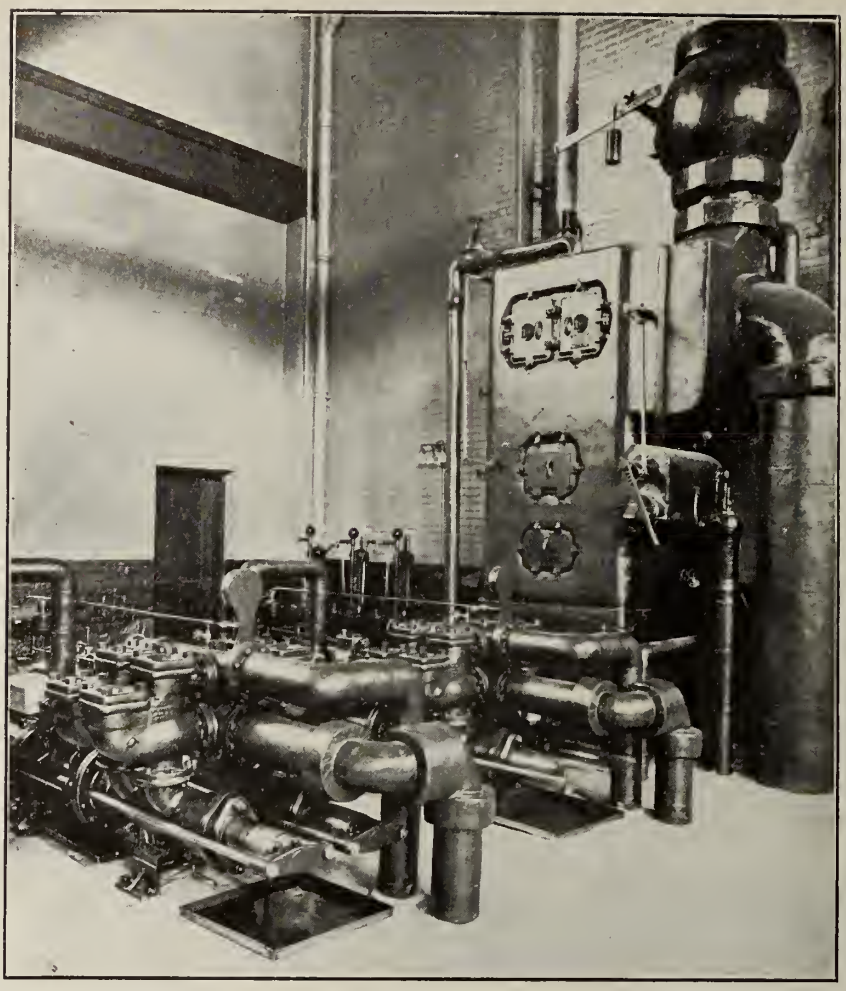


Fig. 7 — Worthington Boiler Feed Pumps, Cochrane Heater, etc.. in Engine Room.

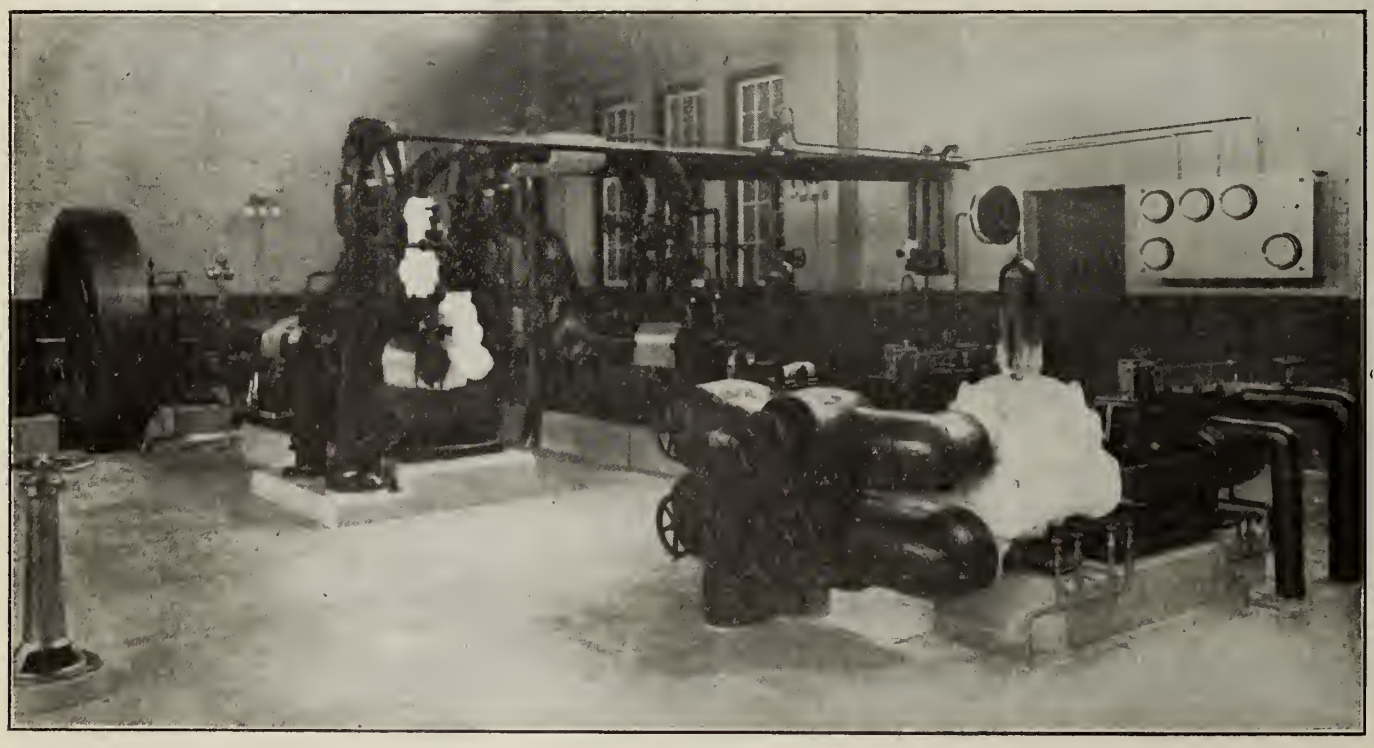


Fig. 5— Linde-Canadian Ammonia Compressors in Engine Room.

Engine Room Piping, Etc.

From the main steam header in the boiler room, 8 inch double line headers pass down into the engine room basement, and are so arranged with valves that repairs, when necessary, are facilitated. One line supplies the main engines, while the other furnishes steam to the pumps and compressors. An 18-inch pipe line, into which all engine and pump exhaust passes, goes from the power house to the Central Depot and Chateau for heating purposes. A 4-inch live steam main carrying a pressure of 85 pounds per square inch—reduced by a Foster reducing valve, also connects with both places. Should a pressure of 3 pounds not be maintained in the exhaust line, a 7 by 18 inch reducing valve on the live steam line provides the necessary addition. A tunnel of ample proportions to enable repairs, etc., being performed is the medium whereby the pipe and other lines make communication between the three buildings.

All steam pipes carrying boiler pressure are covered with 85 per cent. magnesia, and finished with ½-inch plastic cement, over which 8 oz. canvas is sewn. All water pipes are of galvanized iron, and Squires steam traps perform drain service on the various high and low pressure mains. The machinery is painted bottle green, the walls light green with dark green wainscoting and the floor a drab color.

The oiling mechanisms are on the Bowser system, and the lockers of Dennis Ironworks. London, manufacture. The oil pumps are of Manzel type; the voltmeters of C.G.E. manufacture; the piping by James Ballantyne, Montreal; the pipe covering by the Canadian Asbestos Co., the overhead cranes by the Dominion Bridge Co., Montreal, the oil separators by Sheldon's, Ltd., Galt, and the Cochrane heater by the Harrison Safety Boiler Works. The lighting is by Tungsten lamps.

Mr. W. H. Sample, master mechanic, Ottawa Division G. T. R., supervised the installation of the plant; Mr. G. M. Wilson looked after the inspection of the various items of the equipment, and Mr. C. Bovair, previously in charge of the G. T. R. elevator power plant at Tiffin, Ont., is chief operating engineer.

FORCED DRAFT SYSTEM SAVING.

THE New York Steam Laundry Co., of Montreal, recently effected a saving of $13.30 a day in their coal bill by installing a Venetian Blind Steam Blown Grate, being the Paillon System of Forced Draught. These grates replaced an automatic stoker, and were installed at the total cost of $375.00. Previously, the furnace required four tons of ¾ lump soft coal at $5.15 a ton. Now, only 2¼ tons of hard coal screenings, at $2.10 a ton, mixed with half a ton of ¾ lump soft coal at $5.15 is sufficient. It was also found that more steam could be produced, for, with the same boiler capacity there was sufficient steam to run the engine as well as the laundry. The engine had to be closed down some time ago on account of lack of steam, and a gas unit was installed. The gas unit is now used as a standby.

H. L. Peiler & Co., Montreal, installed the apparatus.

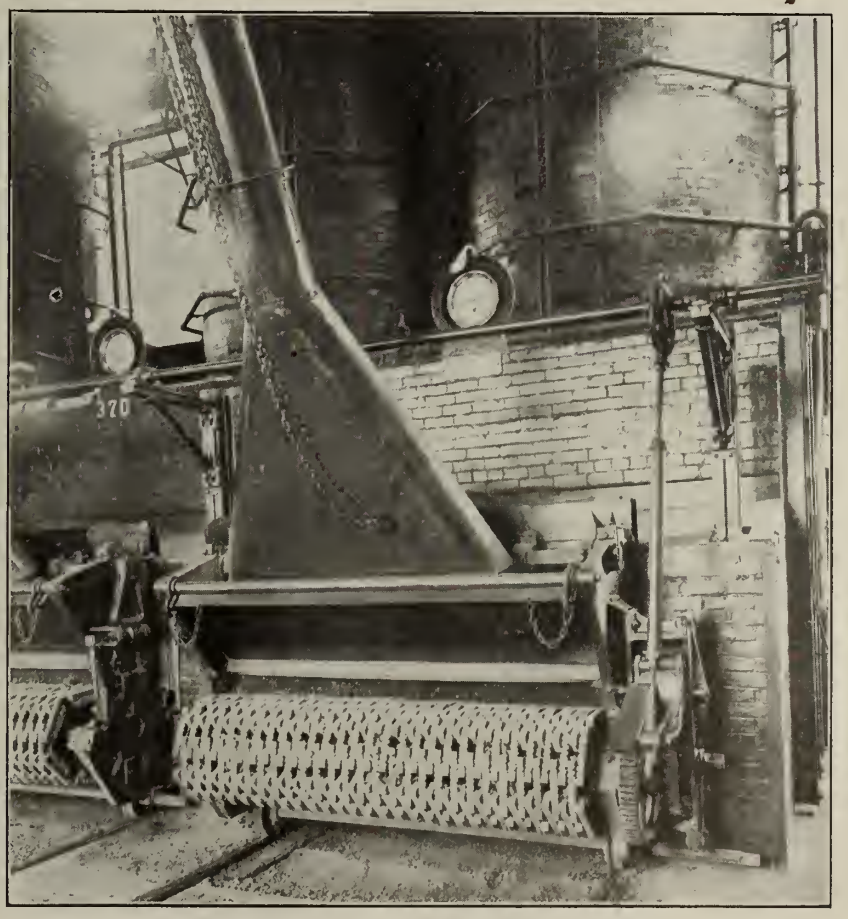


Fig. 3 — Unit Detail of Stoker and Boiler Front.

ELECTRIC SPARKS.

FOR the electrical operation of large valves in steam or water pipe mains, the squirrel-cage induction motor is recommended on account of its simplicity by H. M. Gassman, in a paper before the American Institute of Electrical Engineers. Such a motor should have a high-resistance secondary in order to produce high starting torque, and should be equipped with an automatic operating device which would prevent starting in the wrong direction, with the consequent risk of damage to the valve-operating mechanism.

* * *

A report of the machine testing station of the Agricultural College at Monte Video gives certain details of the comparative running costs of various types of motors in Uruguay, and particularly in Monte Video. From these details it appears that electrical power in Monte Video is relatively cheap, and that it is particularly profitable for small industrial purposes. A much extended use of the Diesel engine is anticipated, particularly as for some little time now the importation of these engines for agricultural purposes has been allowed free of duty. It appears that the first motor plough trial was made only last year in Uruguay, and now there are more than fifty in use.

The man who trades on the ignorance of his fellowmen, or goes on the theory that he knows more than anybody else, and is not going to let anyone into his institution or see what he is doing, generally wakes up some day to find that the world has moved on, and he is only clinging to it by a very precarious tail-hold.—Ex.

The Present State of Development of Large Steam Turbines*

By A. G. Christie, Madison, Wis.

The author of this paper goes very fully into the steam turbine question, and while indicating the outstanding features of the different designs with which are associated the names of the personages from whose brain they have emanated, shows that the most successful products in this field at the present time are those which combine the good points of two or more types, and have deleted the objectionable features previously existing in each individually.

IN the early days of steam turbine building, it was difficult to secure suitable materials to withstand the stresses set up at high speeds of rotation; but as the demand for these increased, much study was given to the requirements for this service, so that it is now possible through the use of more suitable material to increase very considerably the speeds of all sizes of steam turbines. Higher steam velocities are possible with increased peripheral speed, and thus fewer rows of blades or stages are required. This results in a shorter and more rigid shaft construction, which is therefore less liable to vibration. Many builders, especially those of Parsons turbines, have found this construction to give an increase in steam economy over the slow-speed types, so that a compact modern high-speed machine is more desirable than the older type.

Blading.

The requirements of a satisfactory blading material are that it shall withstand without deformation stresses due to centrifugal force, and temperature or pressure changes, that it shall not cut out with high velocities of steam, and that it shall withstand the corrosive effects of moisture. Parsons turbines have used special bronzes and copper-nickel alloys, while steel blades have also been used in some cases. In these turbines, the steam velocities are low and there is usually no cutting on this account. The principal problem with this blading is to manufacture it cheaply and secure it in such a manner that it will withstand all stresses to which it is subjected.

The number of rows of blades in any given type depends entirely on the size and speed of the unit, the steam conditions under which the turbine will operate and the heat drop per row or stage assumed in the design. Each designer selects such conditions as his experience and judgment lead him to consider the most satisfactory. It is thus hard to draw any general conclusions as to the most desirable number of rows for any class of turbine. In general, it may be said that the Parsons turbines require from 40 to 80 sets of moving and stationary blades, the Curtis from 4 to 8 stages, the Rateau from 12 to 25 stages, the Zoelly from 8 to 20 stages, while the Curtis-Parsons and Curtis-Rateau combinations of course require several rows less than the fundamental types.

Nozzles.

The high pressure nozzles in impulse or combination turbines are made of bronze or nickel steel highly polished inside and placed either in the upper end of the casing itself, or, more preferably, in a separate steel casting which bolts upon the casing. In the latter construction the casing itself is never subjected to the high temperature or pressure of the entering steam. The nozzles in the diaphragms between stages are usually made of nickel steel or other special steel, bent to the proper form and cast in place in the diaphragm body. Some manufacturers use brass nozzles in place of steel made up in sections and riveted or bolted in place. All these passages must be smooth and preferably very highly polished to reduce friction losses. After the first stage, all nozzles have parallel walls on the discharge side.

Bearings and Lubrication.

Practice varies widely with regard to the design and construction of journals and bearings. Builders of impulse turbines invariably use cast-iron bearing shells provided with spherical self-aligning pads and lined with white metal. These are being used to an increasing extent on Parsons turbines and without exception on all low-speed units. Some manufacturers still retain the original Parsons form of bronze bearing shell with concentric rings on the outside separated from each other by oil films. It has been claimed for this type of bearing that the oil films dampen any slight variation of the spindle and thus provide a quieter running machine. Experience has shown that this is not always the case and that such a bearing is often a real source of danger when the added clearance of the spindle due to play between the rings is taken into consideration. This construction is also much more expensive than the white metal bearings.

In Europe many turbines are run with a minimum amount of oil and with oil leaving the bearings at a temperature of 190 deg. Fahr. This practice is based on the argument that such a system of lubrication requires the least expenditure of power for oil circulation and in friction losses. However, practice seems to be tending towards flooded lubrication, in which a great quantity of oil at a temperature of about 100 deg. F. is forced through the bearings by a pump of the rotary, centrifugal or gear type, driven from the main shaft of the turbine. The oil pressure at the bearings varies from 3 to 20 lb. per sq. in. The life of the oil is much longer in this system than with very hot oil and any wear on the bearings themselves is absolutely prevented. Occasionally the bearing shells are water-cooled, but this practice should be discouraged. Cooling water can be used much more satisfactorily outside of small oil pipes in properly designed coolers. In case the water is dirty or full of scale-forming impurities, these can be more readily removed from an oil cooler than from the interior of a bearing shell.

Flooded lubrication has enabled manufacturers to cut down the length of their bearings and thus reduce the total length of their turbines. The increased pressures per unit area on the bearings have not introduced any difficulties, so that pressures of 80 to 100 lb. per sq. in. at a surface speed of 60 ft. per minute are common practice. The best results are usually obtained with a temperature of about 125 deg. F., as the oil leaves the bearings.

Spindle Construction.

Parsons turbines in America are usually built with a hollow quill into which the journal ends are forced and fastened by shrink links or bolts. The high-pressure blading is placed in grooves in one end of the quill itself. The intermediate and low-pressure blades are usually carried on cast or forged-steel rings which are afterwards forced and keyed upon the central quill. In Europe excellent hollow steel forgings can be obtained very readily, and hence the spindles of Parsons and other drum type turbines are usually made up of one forging with the journal shafts fastened into the ends. The shafts of impulse turbines are usually in one piece and carry the blade disks, which are high-grade steel or nickel-steel forgings or castings. These disks are fitted and keyed on the shaft and held in place by shrink links or lock nuts. It is quite general practice now to design the shafts so that the

*Part II. of Paper read at the spring meeting of the American Society of Mechanical Engineers.

normal speed of the turbine will be very considerably below the critical speed due to any slight unbalancing of the mass that may be present. This removes the dangerous vibrations often experienced when passing through critical speeds, and permits closer clearances to be used on Parsons blading and in the labyrinth passages in the diaphragms between the stages of impulse turbines.

Packing Glands.

A small impeller supplied with water is provided on all American built Parsons turbines to form an air seal at the shaft glands. European builders prefer to use labyrinth packings with live or throttled steam as an air seal. The objection raised by foreign builders to the water packing is that it takes too much power to drive the impeller, and that it provides a condensing surface for the steam. The amount of water required in a well-designed gland is very small, and there is no great circulation. Thus, the water can have only a small effect as a condensing medium. Usually the steam directly inside the casing is under vacuum and then condensation would not be objectionable. It requires considerable steam to pack the labyrinth type of gland, and this loss often exceeds that due to the power required to drive the water impellers.

Impulse turbines use carbon rings at the high-pressure gland, especially when superheated steam is used. The leakage past the first rings is carried through a passage and pipe to the low-pressure glands to act as a vacuum seal. The labyrinth packing in the diaphragms is usually of bronze in the high-pressure stages and frequently of white metal in the low-pressure section. The low-pressure shaft glands are made either with carbon or labyrinth packing, sealed by steam.

Thrust Bearings.

Thrust bearings are now provided on all types of turbines. These serve to adjust the position of the spindle and to take up any end thrust present. The end thrust in well designed turbines is usually of small amount and seldom causes trouble. These bearings are usually flooded with oil and are often made with bronze rings which can easily be replaced in case of damage.

Several builders of Curtis-Parsons turbines have substituted an oil thrust piston for the steam balance piston of the usual form. This piston is placed on the governor end of the shaft outside of the casing proper. The thrust is taken up by oil which is supplied under pressure and which can escape only through sets of labyrinth baffles on the piston and on the surrounding chamber. The piston adjusts itself for the amount of thrust present by a small axial movement of the shaft, thus opening or closing the discharge area for the oil through the labryinth baffles, and automatically varying the oil pressure on the face of the piston. This arrangement does away with the loss of steam through balance pistons and should improve the turbine efficiency, though a small amount of power is required to pump the oil.

Governing Devices.

The speed of Parsons turbines is usually controlled by a centrifugal governor of the Hartung or similar type which regulates the position of a balanced poppet valve through the medium of a steam or oil relay. The latter type is coming into more general use on account of its many advantages over the steam relay. The steam is throttled either at constant pressure or by a pulsating action.

Impulse turbines, and turbines employing a Curtis high-pressure ring usually govern by means of Hartung type governors and oil relays. The speed is sometimes controlled by simple throttling of the steam, which practice is common in Europe. In this case, additional nozzles can be opened or closed by hand as required. This system would, however, be unsuitable with violently fluctuating loads. Other types employ both throttling and automatic nozzle regulation, while, again, many turbines, particularly of the Curtis type, are built for nozzle governing alone. In Europe, there is a difference of opinion as to the most economical method of governing. M. H. Zoelly claims that he gets the best results on his type of turbine by throttle governing. It is generally admitted, however, that impulse turbines give the best results by controlling the number of nozzles that are open at any load. With such control, the pressure before the nozzles in service is always the normal pressure for which these are designed. The General Electric Company govern their turbines above 300 k.w. by means of an oil relay system which operates through a piston and camshaft to open or close nozzles as required by load conditions.

HEAVY OIL ENGINES.

IN his second and third Howard lectures to the Royal Society of Arts ou heavy oil engines, Captain H. R. Sankey described in detail the construction of various makes of Diesel engines. There are not to be found, he said, in this class of engine the enormous variations in design which are to be seen in steam engines, so that his task was confined to pointing out minor features of difference. He showed an exhaust heater for Diesel engines, which extracts from the exhaust 8 to 9 per cent. of the total heat originally available in the oil. By employing different sizes of cylinder, and putting a series of them on one shaft the makers are able to produce combinations of cylinders which give any required size of engine. The weight of a Diesel with flywheel is about 500 lbs. per b.h.p.

Speaking of large engines, the lecturer said that the firm of Sulzer have made cylinders each of 2,000 h.p., and the M.A.N. are also experimenting with similar sizes. Carel's make a 1,000 h.p. cylinder, and many makers are now prepared to undertake the construction of 6,000 and 8,000 h.p. engines, without further experimenting. About one million h.p. is his estimate of the total output of Diesel engines now running. Turning to the question of fuel, he said it is an important characteristic of the Diesel engine that it will work with every kind of oil, whereas explosion engines are very sensitive to the class of oil with which they are supplied. The reason for this is that the compression has to be kept down to avoid pre-ignition.

Oil Properties.

The important properties of the oils are chemical combination, viscosity, specific gravity, ignition point, flash point, residue and chemical combustion. A fuel testing laboratory has been started at Zurich, and the National Physical Laboratory, London, is also engaged in the preparation of a similar equipment. The oils contain carbon, hydrogen, and slight sulphur which is an impurity. Crude petroleum has from 82 to 80 per cent. carbon and 18 to 14 per cent. hydrogen. Coal tar oils have 90 per cent. carbon and 8 per cent. hydrogen. The percentage of hydrogen is important, as it affects the ignition point of the oil, and when hydrogen is present only in small quantity, the ignition may not be satisfactory. No trouble is experienced over the viscosity, for if too high it can always be lowered by means of a little lighting oil. The specific gravity is only of interest as giving an idea of the class of oil. The flash point question is wholly a matter of storage.

The impurities usually met are water and sulphur. Water must not exceed 1 per cent. and sulphur 2 per cent. As to calorific value; two values are often quoted, a higher one and a lower one, and as these are often quoted loosely, care has to be taken that a quotation is properly labeled. The higher one is a calorimeter value and includes the latent heat of the steam, which, of course, is not utilized in the engine. The difference between the two values is considerable, and Captain Sankey in his calculations uses the rule:—

Lowest calorific value = Highest or calorimeter value 10,300 $\times$ percentage of hydrogen in fuel.

The "Bettington" Water-Tube Boiler for Atomised Fuel

By C.T.R.

The type of boiler illustrated and described in this article presents many novel and attractive features worthy the consideration of steam power users. The claims for high efficiencies from low-grade fuels, the elimination of stand-by losses, the capacity for large over-loads, and the absence of smoke emission are each and all ideals aimed at and sought after by every manufacturing and central station steam plant management.

THE Bettington boiler is especially designed for burning with high efficiencies low grade fuels, of so poor a quality, that it is almost an impossibility to burn them in a practical manner in any other boiler. Broadly speaking, the advantages of this system are comparable to those obtained by oil fuel firing, the two methods being not dissimilar in many respects. In both cases, the fuel, whether coal or oil, is atomized, and before entering the combustion chamber is intimately mixed with the necessary air for combustion. This intimate mixing of air and fuel ensures better combustion with less air than usual, and with a consequent increase of boiler efficiency by reducing the amount of heat carried away by the escaping gases.

Chief Features.

What appear to be the chief features from an electrical power station engineer's point of view, are:—

(a)—The almost total elimination of standby losses, as all the fuel is burnt in suspension; the amount of unconsumed coal in the furnace at any given time being infinitesimal, and, therefore, as soon as the supply is stopped (which can be done instantly) no further losses take place.

(b)—The rapidity with which steam is raised under ordinary conditions. The system differs from others in that with ordinary furnaces some time is taken before the fires are completely alight, but in this case, as soon as the boiler is fired, full theoretical effect is obtained.

(c)—The smallest and cheapest kinds of "slack" are burnt with ease, and high efficiencies are obtained.

(d)—The arrangements which permit of a close inspection of the straight vertical tubes.

(e)—The reduction of supervision necessary.

Fuel Feed Arrangements.

In these boilers, coal is fed by means of a worm from a hopper into a chute leading into the casing of an electrically driven pulveriser. A view of the pulveriser is seen in Fig. 1. This pulveriser has two functions; first to disintegrate the coal and second to give the air supply the requisite pressure and the fuel the requisite velocity. A mixture of hot air and fine particles of fuel, after leaving the pulveriser, first enters a dust chamber at a pressure of about 1.5 inches of water. The fine particles pass on to the tuyere or burner, whilst the coarse ones return by gravity to the pulveriser for regrinding. Air, preheated by the waste gases, is employed for the blowing, being fed in at the bottom of the blower. In Fig. 2 is seen a sectional elevation of a 12,000 lbs. per hour boiler, fitted with a superheater and air heater. The air for combustion is drawn by the fan from the air heater, which is situated on top of the boiler. The burner, of mild steel, is water jacketed by the feed water, thus forming a mud drum and feedwater heater.

Combustion Chamber Arrangement.

The mixture of fuel and air leaves the burner and enters the furnace, which is of vertical cylindrical form. The boiler itself consists of mild steel top and bottom headers with vertical steel tubes connecting them. There are doors in the top header through which tubes may be withdrawn. A steel expansion pipe connects on the outside the top header to the superheater, in which there are several rows of tubes arranged concentrically, and a special brick lining surrounds the innermost circle of tubes. The combustion chamber is so arranged that the vertical gas jet produces, within the closed ring of tubes, a mushroom shaped flame. The incoming stream of dust and air is heated and ignited by the enveloping sheath of products of combustion, which are at a temperature of about 3,000 degs. F.

The mixture rises to the top of the boiler and returns down the sides of the

Fig. 1—A Standard Pulverising Fan and Carburettor or Dust Separating Chamber.

furnace, then up along the outside tubes, through the air heater and finally to the stack. No air is admitted except through the burner, and, therefore, the air supply is entirely under control. For this and other reasons, as will be observed during the course of the description, it is so efficiently utilized as to approximate more nearly to the theoretical value per lb. of coal than is usually the case. On entering the furnace, the air loses its velocity much quicker than the solid particles on account of friction and expansion, consequently a solid particle is continually changing its surroundings and encountering fresh supplies of oxygen, on which it may draw to complete its combustion. This applies both to the upward and downward journeys.

Ash Feature.

A peculiarity of the furnace is the form of the ash. In its passage through the high temperature zone, the ash is converted into liquid spray. Some of this spray falls to the bottom of the furnace, while some of it strikes the brick lining of the furnace and in time trickles down to the bottom edge, being kept in the molten state by the descending gases, eventually reaching the space provided at the bottom of the furnace in the form of small globules of 0.25 to 0.5 inch diameter, which are in a manageable form and can be dealt with by an ash conveyor or raked out once every 12 hours. In this way the furnace automatically clears itself of slag. The properties of this liquid spray are turned to advantage in the furnace. No fire clay is used, the firebricks being simply stacked in position, and on firing for the first time, the gases take the opportunity of passing by a shorter way to the stack, sucking in the liquid after them. This soon solidifies, and having a high melting point, chokes up all crevices and even large holes, at the same time cementing the lining into one solid piece, as well as glazing the inner surface.

A Prominent Characteristic.

One of the main characteristics of this boiler is the extremely low stand-by losses. There is no "banking," and the only stand-by losses are those of radiation. The fuel supply is cut off when the boiler is taken off the range, and put on at intervals in order to keep up the steam pressure. To light the boiler after putting on the fuel supply a torch is held to the jet, which immediately ignites. Of course, it should be remembered that the boiler is not restricted to coal for fuel— waste gases, oil or a mixture containing gases and dirty coal or slack are quite readily dealt with.

Claims Made for This Boiler.

The general idea of the working and principles of the boiler now being fixed in the reader's mind, he will be in a position to grasp the justification for making the following claims:—

It is admitted that a steam boiler of the orthodox, generally accepted type fitted with grates is a most difficult problem, as the grates become choked, the supply of air is irregular, being insufficient in some places, and in excess in others; further, the design of apparatus for the control of coal and air supply leaves something to be desired, as even assuming the coal supply to be regulated correctly for a given fluctuation in the load, the amount of air regulation must necessarily be somewhat of a speculation; and in possibly the average case considerably more air gains access than is intended, through cracks, etc., in the setting of the boiler and grate. The inference, then, is that there is a great deal to be desired, and a boiler and furnace that would overcome the majority of these defects would be well received by the station engineer who is anxious to effect a high economy.

Orthodox Type Boiler.

Assuming a boiler is properly set, and in good order, its economy then depends entirely on the regulation of the fuel, and air supply.

It is well known that, broadly speaking, the weight of the flue gases decrease as the percentage of CO_2 increases, and a high boiler efficiency requires a high percentage of CO_2. Again, too high a percentage admits of the possibility of incomplete combustion, shown by CO being evolved through insufficiency of oxygen; therefore, a medium must be struck by experiment, which appears to vary between 13 and 16 per cent. CO_2, according to the class of fuel.

With a fluctuating demand for steam, considerable losses are experienced when

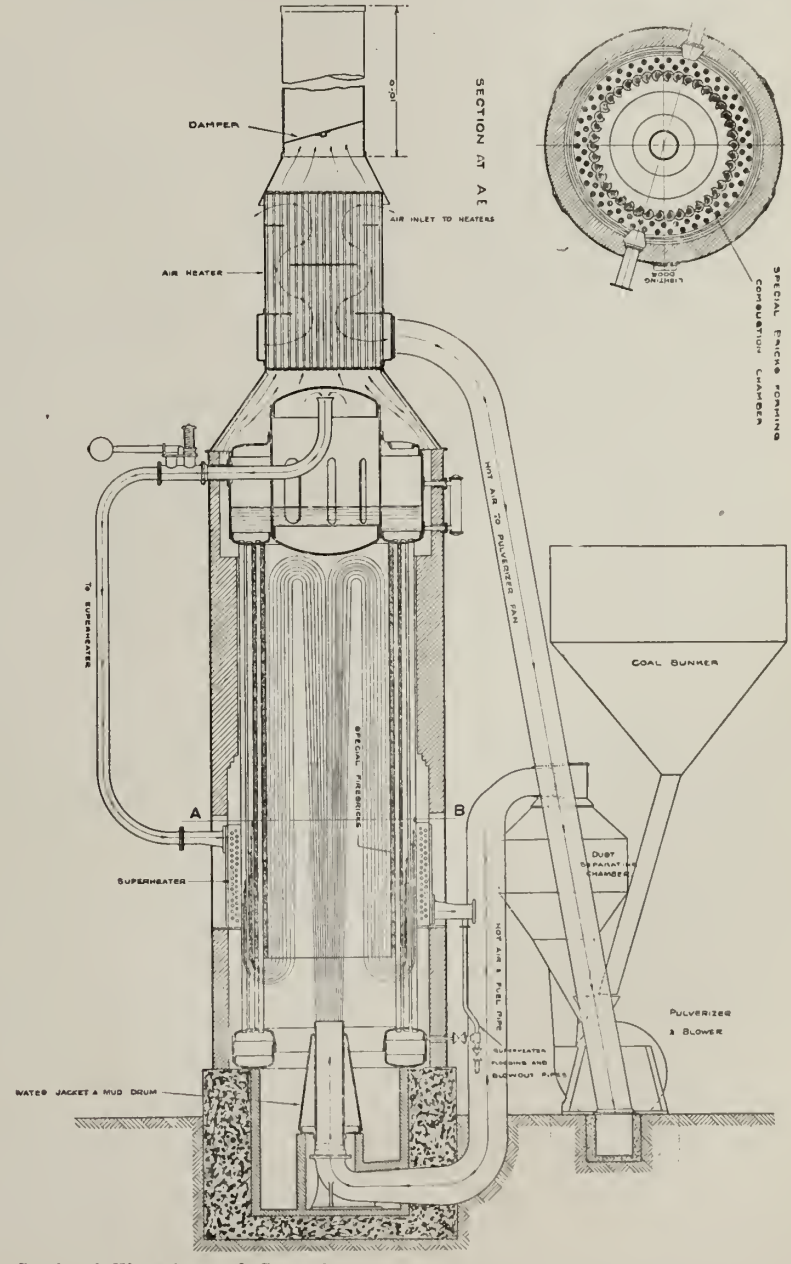


Fig. 2—Sectional Elevation and Cross Section of Standard Boiler, showing Path of Gases.

the load goes off, and the amount of coal on the grates is large and has to be burnt.

The burning of bituminous coal in ordinary boilers is generally accompanied by the production of considerable quantities of smoke. This is due to the chilling of the gases evolved below the degree of temperature necessary to allow of complete combustion, by coming in contact with the boiler tubes, or else by the introduction of excessive quantities of cold air.

Fuel and Air Supply.

The fuel supply is susceptible of the closest regulation, by means of a slide admitting the coal, and the speed adjustment of the pulverizer feeder, by means of a stepped cone and friction drive.

The air supply is pre-heated, and is entirely confined by the movement of a slide. The amount is determined by observation of the flame color through a small mica window, which gives an almost instantaneous indication of the relation of air and coal.

The close air regulation admits of maintaining any percentage of CO_2 desired.

The design of the boiler precludes any possible leakage of air from cracked settings, as the only brickwork where it could possibly leak is not exposed to high temperatures; the rest of the boiler being enclosed in brickwork lagged on the outside with steel having asbestos joints.

The amount of unburnt fuel in the Bettington system is negligible, and should it even be desired to extinguish the fire, same is done instantly by throwing the pulverizer out of gear.

The Bettington furnace is so designed that combustion is complete before any of the gases can come in direct contact with the cooling influence of the boiler tubes, hence the boiler is most suited to deal with bituminous fuels, and, further, to burn them without smoke.

The use of an automatic continuous CO_2 recorder is most advantageous here, especially as its adoption can be attended with solid results. Although the instantaneous air adjustment required by a new condition in the demand for steam is apparent, and regulated by the flame color as before mentioned, by the use of a CO_2 recorder the fact that this air regulation has been accomplished correctly is only conveyed to the fireman several minutes later, due to the time taken for the flue gas to flow to the recorder. The recorder also ultimately shows the engineer that the stokehold men have done their work conscientiously.

Bettington Boiler Service Records.

The boiler at Messrs. Fraser & Chalmers' works has now been running for over four years. It has 2,606 square feet heating surface, with a single 14-inch tuyere; and although intended to yield only 10,000 lbs. hourly, it has done 22,000 lbs. with ease. One fact brought out in practical operation is that the boiler is capable of heavy overloads. This has been demonstrated unmistakably when used for coupling up to a turbine wheel testing machine in which the steam consumption was extremely high for short periods. Steam can be raised from cold water in 20 minutes. The results of some tests on this boiler follow, the two columns relating to two tests on the same boiler at different rates, with a fuel valued at 11,870 B.T.U's per lb.

	Normal Rate	High Rate
Rate of coal feed per hour, lbs.	879	2,733
Lbs. of coal feed evaporated per hour	6,829	17,307
Feed temperature deg. F.	60	64
Absolute pressure, lbs. per inch	165	165
Equivalent lbs. of water evaporated and superheated from and at 212 deg. F.; lbs. per hour	8,714	22,374
Lbs. of water evaporated per lb. of coal from and at 212 deg. F.	9.71	8.18
Boiler efficiency per cent.	79	66

The writer is indebted to Fraser & Chalmers, Limited, No. 4 Phillips Place, Montreal, for the illustrations accompanying this article.

NEW REFRIGERATING SYSTEM.

AT the instance of Mr. Wilfrid Stokes, chairman and managing director of Messrs. Ransomes & Rapier, Ltd., 32 Victoria Street, London, Eng., a demonstration machine, working with carbonic acid, has been constructed to show the advantages of the multiple effect compression system of refrigeration invented by Mr. Gardner T. Voorhees. An ordinary refrigerating plant can be adapted to this system by the addition of a vessel, known as a multiple effect receiver, having a second expansion valve in connection therewith, and a mechanically operated valve for admitting the gas from it into the compressor at the end of the suction stroke, so as to give multiple effect compression.

The multiple effect receiver is an arrangement for separating the mixed gas and liquid coming from the first expansion valve; the liquid passing to the evaporator and the gas to the multiple effect compressor. The latter apparatus during a suction stroke takes in vapor at two or more different pressures, one after another, so that without mechanical effort, the gas is partially compressed by the super-imposed charge from the separator vessel. Thus, the capacity of the machine for refrigeration is increased, because more vapor is pumped for each stroke of the compressor. Other sources of economy in the arrangement are that a large proportion of the gas is never reduced to the evaporated temperature, and that the clearance and leakage losses being constant, while the mechanical friction losses are practically so, they constitute a lower percentage of the increased output.

The least possible saving in power is estimated at 20 per cent., and it is stated that in practice 50 per cent. may often be saved. The system, which is the subject of a long article in a recent issue of "Ice and Cold Storage," is of interest to users of refrigerating machinery, especially in warm climates, since on carbonic acid machines the drop in output is very considerable with cooling water at 80 or 90 degs. F. The Voorhees system affords a means of compensating the plant deficiencies in such circumstances.

ELECTRIC LOCOMOTIVES.

EXPERIENCE with electric working on the New York, New Haven, and Hartford Railroad has now resulted in no less than seven kinds of locomotives being built. The original type was evolved to meet the troublesome conditions of the company's service into New York, where both alternating and direct currents are employed. For combined freight and passenger service there is a second type of locomotive, consisting of two sections, each having two driven axles in a rigid wheel base and a pony truck. This is used for single-phase operation in the Hoosac tunnel. There are also two experimental types, one modified from the second type and the other equipped with side rods. Still another type is a group of switching locomotives solely for alternating current, while another type is intended for combined freight and heavy passenger service. Finally, there is the new Colonial type designed particularly for fast, heavy passenger service.

In all, the company now possess 82 locomotives of these seven types. The Colonial locomotives are particularly interesting on account of the use of three separate wheel bases, consisting of two four-wheel radial trucks and two pairs of rigid drivers in the centre. Each radial truck has a pair of driving wheels and a pair of small pilot ones. Each pair of drivers is provided with two motors permanently connected in series, and having pinions geared to the same axle sleeve, by which several advantages in operation are obtained, including light construction and economy in the space required for the mechanism.

Boiler Scale, Its Causes, Danger and Prevention

By Geo. D. Fowler

The present day demands on the steam boiler, to generate steam not only rapidly and economically, but its ability to carry safely, the prevailing high pressures in addition, call for the exercise of every possible measure whereby the deposit of scale and sediment will be limited in the highest degree and the application of the means through which its removal, when formed, will be at once effective and safe.

INCRUSTATION or scale as distinguished from mere sediment due to dirty water, which is easily blown out, or gathered up by means of collectors, is due to the presence of salts in the feed-water, carbonates and sulphates of lime and magnesia for the most part, which precipitate when the water is heated, and form hard deposits upon the boiler plates.

If the quantity of these salts is not very large, (say twelve grains per gallon), then scale preventives may be found effective. The chemical preventives either form, with these salts, other salts, soluble in hot water, or will precipitate them in the form of soft mud, which does not adhere to plates and can be blown or washed out from time to time. The selection of the chemicals must depend upon the composition of the water, and their introduction should be regularly with the feed.

Quality of Feed Water.

Commercial analyses of the water are made to determine, (1) its fitness for making steam; (2), its hardness or the facility with which it will "form a lather" necessary for washing; (3), its adaptation to other manufacturing purposes. The most common commercial analysis of water is made to determine its fitness for making steam. Water containing more than 60 grains of total residue per gallon will usually cause troublesome scale, and should condemn its use in steam boilers, unless a better supply cannot be obtained. The total residue in water used for making steam causes the interior linings, or surfaces below the water-line of the boiler to become coated, and often produces a dangerous hard scale which prevents the cooling action of the water from protecting the plates against overheating. Some waters carry a percentage of lime and magnesia bicarbonates, which are determinable by analysis, and, while their excess of carbonic acid is present, are held in solution. When, however, the carbonic acid is boiled off, the bicarbonates will usually precipitate, and, with the other solid residue which is constantly being formed by the evaporation, will produce a very hard and insoluble scale.

Forms of Scale.

Some of the forms of incrustation, or scale are: — Deposition of suspended matter; deposition of deposed salts from concentration; deposition of carbonates of lime and magnesia by boiling off carbonic acid which holds them in solution; deposition of sulphates of lime because sulphate is only slightly soluble in cold water, and less so in hot water, while insoluble altogether above 270 degrees F; deposition of magnesia, because magnesia decomposes at a high temperature such as is due to a high pressure of steam; deposition of lime soap or iron soap, etc., formed by saponification of grease. The composition of ordinary boiler-scale may be reckoned as follows: —Sulphate of lime, 34.71 per cent.; carbonate of lime, 47.78 per cent.; magnesia, 12.95 per cent.; silica, 2.74 per cent.; peroxide of iron, 0.69 per cent., and water, 1.13 per cent.; making a total of 100 per cent.

Where the quantity of salts is excessive, then scale preventives are not of much use. Some other source of water supply must be sought, or the bad water purified before it is allowed to enter the boilers, for the damage done to boilers by unsuitable water is enormous.

Scale Prevention.

Scale may be prevented chemically, by treating the water inside the boiler, or before it enters. Of the two, the latter is rather more preferable. It is necessary to have a chemical analysis of the water in order to determine fully the kind and quantity of preparation to be used for prevention of scale. The Bavarian Steam Boiler Inspection Association reported in 1885, as follows: "Generally the unusual substances in water can be retained in soluble form, or precipated as mud, by adding caustic soda, or lime; this is especially desirable when boilers have small steam spaces. All secret compounds for removing boiler-scale should be avoided. Such secret preparations are either nonsensical or fraudulent.

The Engineering News, under date of December 5th, 1891, reports as follows: "The Chicago, Milwaukee and St. Paul Ry., Co. uses for the prevention of scale in locomotive boilers, an alkaline compound consisting of 3,750 gallons of water, 2,600 lbs. of 70 per cent. caustic soda, and 1,000 lbs., of 58 per cent. soda ash." Mr. H. E. Smith, the chemist for the above company, writes in May, 1902, that "this compound was abandoned some years ago, and a commercial soda-ash,—58 per cent. soda, and containing about 97 per cent. pure carbonate of soda substituted. This was placed in the locomotive tender tanks where it dissolved and passed to the boiler. Its action is to precipitate a portion of the scale forming solids in a flocculent form, so that they are kept loose and free from the metal, until they can be blown or washed out. The amounts used vary according to the character of the water, and are based on the following rules:—For calcium and magnesium sulphates and chlorides, use soda-ash to the chemical equivalent of those compounds present. For calcium and magnesium carbonates, the amount of soda-ash to be used varies from nothing, when sulphates or chlorides are high, up to about one-fifth the equivalent of the carbonates, when sulphates, and chlorides are low or absent. A few waters contain carbonate of soda, originally and, for these, less soda-ash or none at all is necessary. It may also be necessary to make some reductions in the dose of soda-ash when large amounts of other alkali salts are present. In any case, it is not desirable to use more than 2 lbs. of soda-ash per 1,000 gallons of water, or more than 10 lbs. per 100 miles of locomotive run, on account of the foaming produced.

The foregoing assumes that the boilers are kept fairly clean and free from sludge, by systematic blowing and washing out. In the upper Mississippi valley, the majority of waters are below 20 or 25 grains of incrusting solids per gallon, and the greater portion of this is carbonates. For these, the above treatment is very successful. With from 25 to 50 grains, increasing difficulty is encountered, on account of the foaming produced by the large amount of sludge, and above 50 grains, soda-ash alone fails to keep the boilers clean, in actual service.

Scale Preventatives—Kerosene, Etc.

Kerosene, or coal oil, has been, by some engineers, highly recommended as a scale preventive. They say that if used in moderate quantities it will not make the boiler foam. It is used for loosening the scale, and for preventing its formation. I do not at all disagree with such recommendation, but I should respectfully advise that if coal oil is used at all, it should be used at first in small quantities; the effect carefully noted, and the quantity increased if necessary to obtain the desired results.

I would most earnestly recommend the total prohibition of all other oils for use in steam boilers, especially those of a fatty or acid nature. Such oils appear to combine with the impurities of the water, and increase the tendency of many boilers to foam, as the oil, with

the impurities, impedes the free escape of steam from the water-surface. This is why a boiler with grease in it, will take more fuel and make less steam, than a boiler which is free from oil or grease. The use of common oil not only tends to cause foaming, but is dangerous otherwise. The grease appears to mix with the impurities of the water, and when the boiler is at rest, this mixture sinks to the plates, and clings to them in a loose, spongy mass, producing overheating, which may lead to explosion. This spongy mass may settle on the crown sheet, directly over the furnace, when the boiler is at rest at night; flatten out somewhat and cover over a surface of perhaps, say 75 square inches. When the fire is again brought up to its usual working capacity, the spongy mass is not moved by the renewed circulation of the water, but still adheres to the plate, preventing the water from protecting the plate from the action of the fire below. Consequently, a portion of the plate directly under the mass is overheated to a temperature at which it becomes soft enough for the pressure to push it down, thus forming a pocket or bad budge, and if the plate happens to burn and fracture, an explosion is likely to occur.

Scale Preventives—General.

Mr. T . T. Parker in a letter to the American Machinist, says: — "Should you find other chemicals not doing any good, try this:—Fifty pounds sal-soda and 35 lbs. Japonica. Put these in a 50-gallon barrel, fill half full of water, and run a steam hose into it, until the mixture boils and dissolves. Remove the hose, fill up with water, and let it settle. Use one quart per day of 10 hours for a 40 h.p. boiler, and, if possible, introduce it as you do cylinder oil to your engine."

Prof. Barr, recommends Taunate of Soda as a remedy for scale; composed of sulphate of lime, and carbonate of lime, although he omits to explain how or in what way it is to be used.

When a boiler is coated with a hard scale, difficult to remove, the addition of about one-third pound of caustic soda per h.p., and steaming for some hours, according to the thickness of the scale, just before cleaning, will greatly facilitate removal of the scale, rendering it soft and loose. This should be done if possible when the boiler is not otherwise in use.

DIESEL ENGINE NOTES.

THE Diesel requires less cooling water than suction gas or steam plants. With a temperature difference of 90 degs. F., about 3 gallons per b.h.p.-hour are required. For a 250 b.h.p. engine the cost of water at 12 cents per 1,000 gallons would be about .9 of a cent per hour if the water were cooled in a tower, with 10 per cent. allowance for evaporation and leakage.

Fuel Specification.

1.—The oil shall be crude, refined or a residue of petroleum.

2.—It shall be free from tar, bitumen, or solid hydrocarbons; and shall also be free from sand, fibrous matter, or foreign solid impurities.

3.—It shall not contain more than 0.5 per cent. of water, nor 1.5 per cent. of sulphur, and shall be free from acid.

4.—The viscosity shall be such that the oil will flow in a continuous stream with a 1-foot head through an 0.5 inch copper pipe 6 feet long, without heating.

5.—Its calorific value shall not be less than 18,000 B.T.U. per pound.

Running Costs.

Features of the Diesel are that its fuel consumption varies little with the size of the plant, nor does it increase largely with the reduction of the load. There is in addition, the absence of stand-by losses. The following figures were obtained on a 50 b.h.p. engine coupled to a 33 kw. generator, and have been verified by the author by repeated tests at irregular intervals.

Load.	Dynamo Efficiency.	Cost per unit with fuel at $10.00 per ton.
Full	88	.322 cent
¾	86	.356 cent
½	83	.416 cent
¼	78	.614 cent

These figures demonstrate the advantage of the Diesel for small stations. There are to-day many small stations laboring in the endeavor to produce cheap energy from dear coal with inefficient plants; in many instances the writer thinks it would pay the owners to substitute Diesels and take their plant to the nearest scrap heap. Further, he makes the point that a steam plant will run almost for ever with little attention, but with reduced efficiency. On the other hand, the Diesel requires to be maintained in good order, or it will not run at all.

Attention is drawn to the amount of inspection that has to be done in the steam station. There is the quality of the coal, the efficiency of the stokers, the condition of the flues and settings, the regulation of the draught, the cleanliness of the boilers and tubes, economizers and so forth, and the condition of the main and auxiliary engines, pumps, condensers, etc. All these have to be carefully watched. With a Diesel, the fuel can be checked easily and simply, so that it may be said that the plant is always under test.

Capital Cost.

When the whole of the plant required by a gas or steam station is considered, the Diesel station costs are little different per k.w. from the costs of these. For small plants, the following prices complete, are given:

K.W.	Price.	Price per K.W.
100	$ 9,750	$97.5
150	13,000	86.5
200	16,300	81.5
300	21,900	73.0
400	26,500	66.5

Life of the Plant.

A properly designed Diesel should not be more liable to breakdown than a steam engine. Only one expensive part, the cylinder liner, is likely to require replacement, and from the experience of an engine running for over two years, no appreciable wear on the liner or piston rings is yet apparent. Many other parts are quite cheap to replace if necessary.

Attendance and Lubrication.

The Diesel requires first class attention to secure reliability, and 90 per cent. of the trouble during running is due to the neglect of attendants. Skilled and experienced men must be employed.

The choice of lubricating oil is a matter of importance; it must be a pure mineral oil with a high flash point. The Diesel is 50 per cent. more costly to lubricate than the steam engine. The lubricating oil must be sufficiently cleared of carbon, and as it has been found impossible to remove the whole of the carbon, and the lubricating passages may become stopped up, it is recommended that the piston be drawn every six months, and the lubricating passages cleaned. This trouble may also arise in the air compressor, and, as an instance, the high pressure air pipe in a compressor once blew off at the joint through the pipe being completely blocked with carbon.

All valves must be kept tight, and it is suggested that each valve should be examined at regular intervals; the exhaust valve every 600 hours, the air valve every 2,000 hours, the fuel valve every 600 hours, and the starting valve every 8,760 hours. Care must be taken against the rust caused by moisture in the air compressor. The compressor pistons should be cleaned every six months, also the air-inlet and l.p. valves.

The foregoing are abstracts from a paper read recently by W. J. Sowter, Dublin, Ireland.

Thawing catch-basins with live steam has recently been done by City Engineer Frederick S. Pankhurst, of Niagara Falls, N.Y. With the first spring thaw it was found necessary to bore holes through the ice in the catch-basins to allow the surface water to run off. This process was slow and laborious, and to relieve the situation, a 25-h.p. engine was mounted on a wagon and a full head of steam turned into the catch-basin, which removed the ice quickly.

Steam Engines for Driving Reversing Rolling Mills*

By John W. Hall

The rapid growth and development of the Canadian iron and steel industry in its many phases, makes this paper particularly valuable and opportune to those having the choice and layout of the driving mechanism to determine and arrange; pointing out as it does, type features of the motor unit worthy of close study and attention.

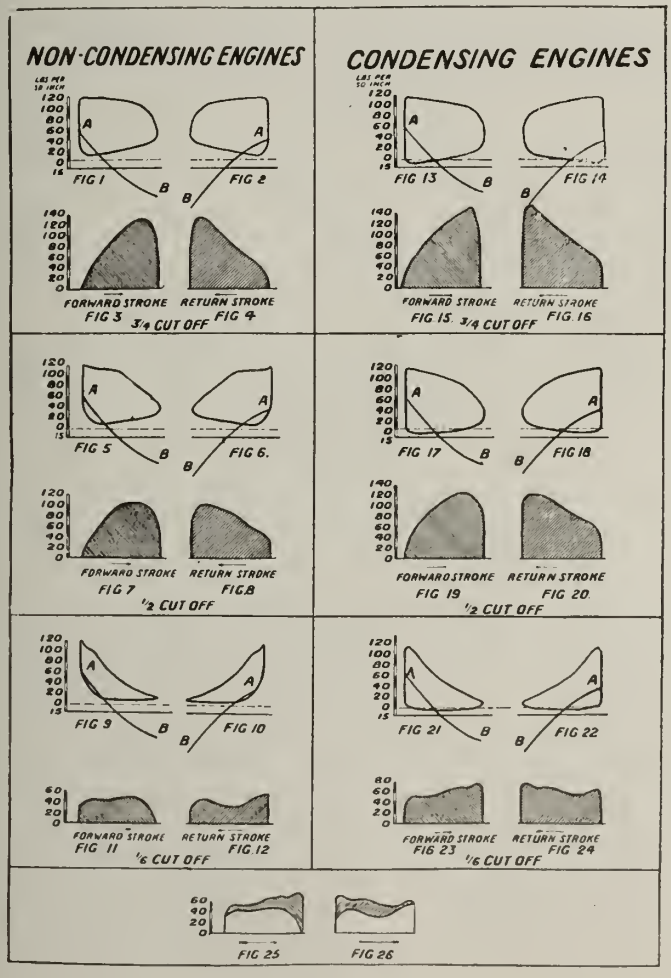
A STEAM-ENGINE working a large reversing mill has to perform the most severe duty demanded of any engine. To drive the rolls fast enough to finish long lengths at a single heat, the piston must run at the highest rate possible, and to attain this speed promptly, there must be a sufficient reserve of power to impart to the crankshaft, immediately after starting, a twist about twice as great as that needed to run the engines up to the full speed, at which they will develop close upon 10,000 horsepower. The engine must be under such perfect control that it can be kept creeping round until the rolls bite the piece to be treated; it must stop instantly when the piece leaves the rolls, and must reverse at once or take it back again. It must gather full speed so promptly that during the last few passes, when the section has become so thin as to cool rapidly, it can be got through the mill before it becomes so hard from loss of heat as to damage the rolls. To ensure promptitude in starting, stopping and reversing, the revolving weights must be low and the steam pressure high; yet the reciprocating masses must be light, or their weight will produce dangerous shocks.

*Abstract of Paper read at the recent meetings of the British Iron and Steel Institute.

Features of Operation.

The engines employed for the work usually have pistons of about 48 inches diameter, with a stroke of about 5 feet, and make about 120 revolutions per minute. At the beginning of each stroke, the reciprocating parts, consisting of the piston with its rod crosshead and connecting-rod, by reason of their inertia, offer a great resistance to movement. The pressure must be high enough to overcome this, and to give them, in one-eighth of a second, a velocity of 31.4 feet per second, which gravity would need nearly a whole second to impart, did they fall freely into space from a height of nearly 16 feet. The initial pressure necessary to do this is about 120 lbs. per square inch. The momentum imparted must then be absorbed, and the parts brought to rest in another one-eighth of a second, or a violent blow will be struck on the crankpin and passed on to the crankshaft bearings, wasting much power in mere destructive hammering of the brasses.

The slowing down is best effected by closing the exhaust port at a fairly early period of the stroke, so as to confine, between the rapidly advancing piston and the cylinder cover, as much as possible of the exhaust steam still remaining in the cylinder from the pre-



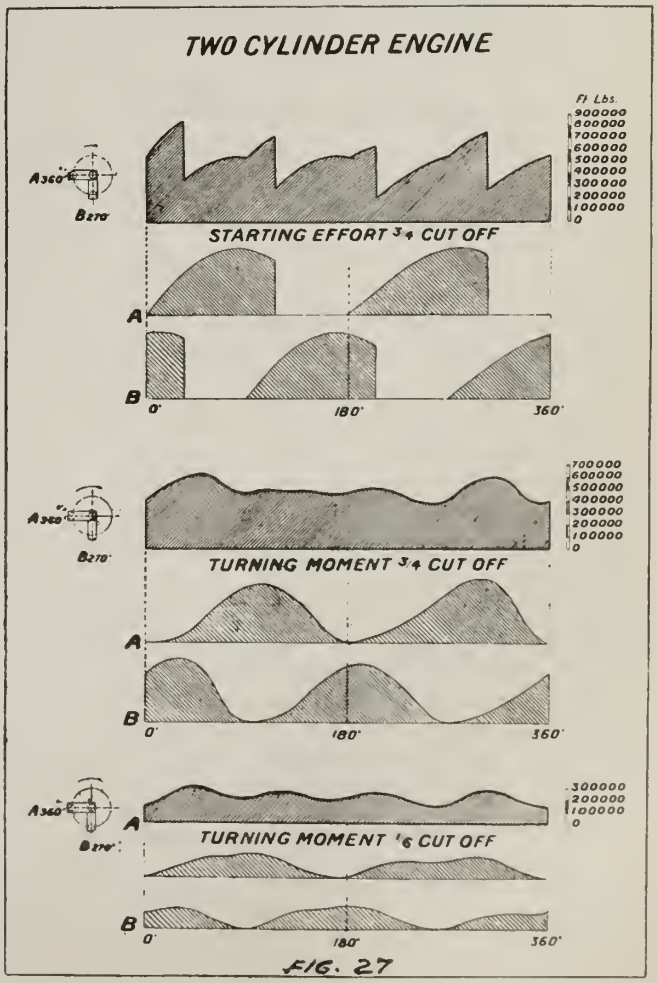


FIG. 27

vious stroke. This is compressed into the port and clearance space, where it will replace an equal weight of live steam, which otherwise would have to be taken from the boiler. In this way, the piston returns energy not utilized in overcoming the resistance of the mill, and stores it for use on its return stroke. The cushion of steam reduces the knock on the pin when the crank turns the centre, and if compression can be carried so far that the cushion pressure is as high as the boiler pressure, say 5 lbs. absolute; this when compressed into one-fourth of the space will rise in pressure only to 20 lbs. per square inch, which will provide a very poor cushion to bring the piston to rest.

Nor, in this instance, is the economy obtainable by using a condenser very great. The temperature of steam at a boiler pressure of 120 lbs.—say 135 lbs. absolute, is 350 degs., at 68 lbs. 300 degs., at 20 lbs. 228 degs., at 17 lbs. 220 degs., and at 5 lbs. 162 degs. F.—absolute pressures in each case. Steam

In the case then of the condensing engine, initial condensation will be considerably greater, and more steam must be taken from the boiler to fill the clearance spaces. Consequently, a condenser, though increasing the power of such an engine, increases also the weight of steam used, so that the consumption per horsepower will not be much less, but the wear and tear will be much more.

Compound Engines.

To reduce the range of temperature, compound engines are sometimes em-

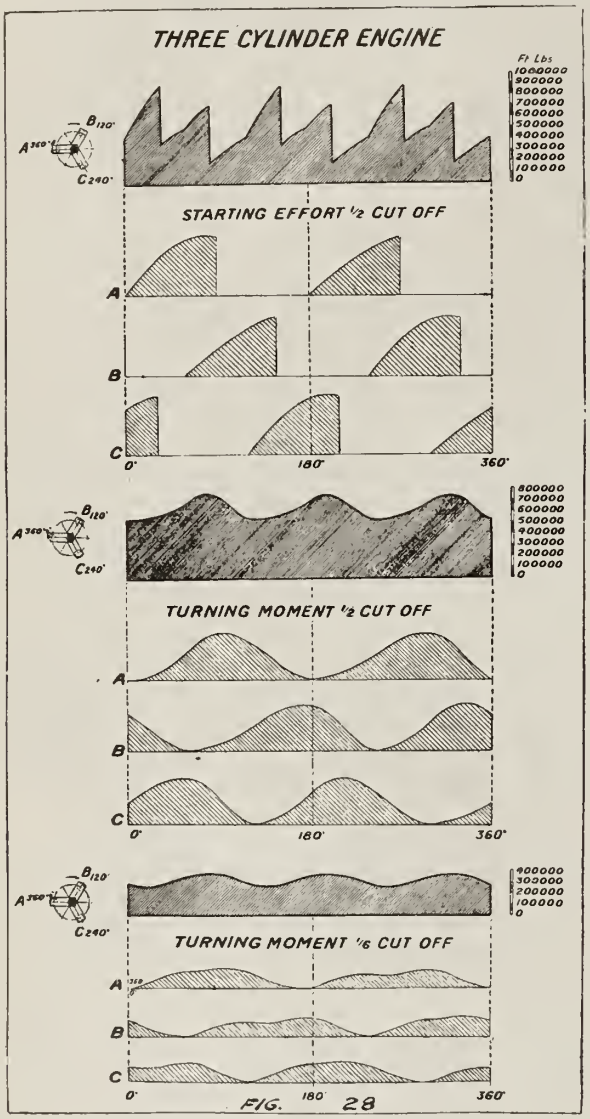


FIG. 28

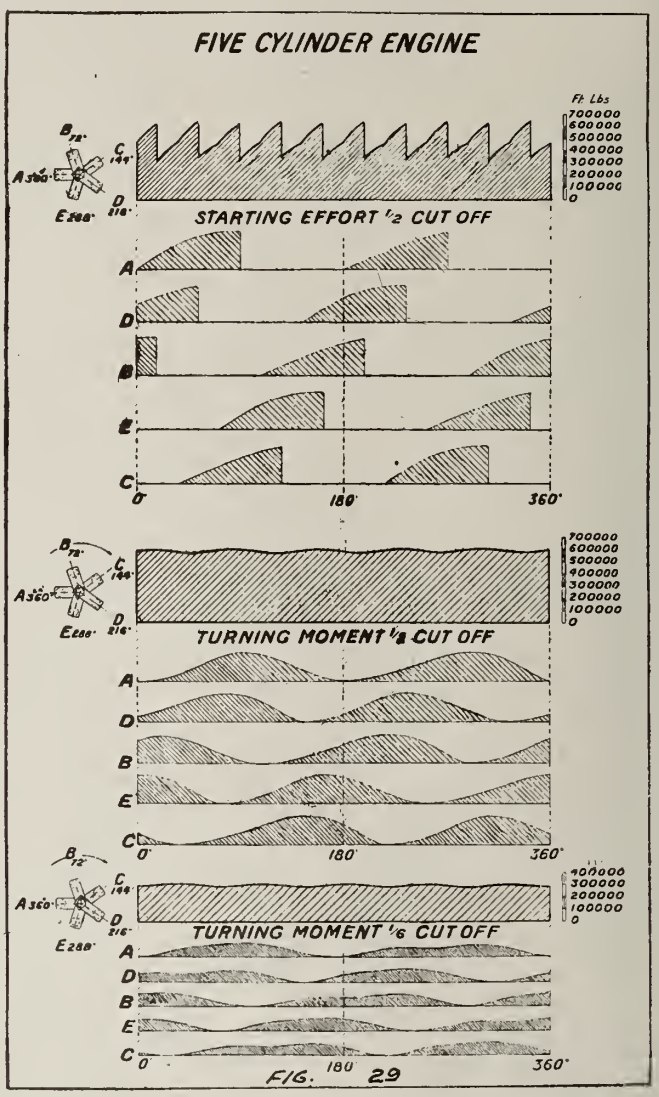


FIG. 29

the whole of the surplus energy is recovered.

Condensing and Non-Condensing Engines.

Now, if the engine exhausts to the atmosphere, the steam remaining in the cylinder may have a pressure of about 2.3 lbs. higher, or 17 lbs. absolute, which will rise in pressure to 68 lbs. when compressed into one-fourth of the space. If, however, the engine exhausts into a condenser, the pressure remaining in the cylinder will be only about 2.3 lbs. above the vacuum in the condenser, or then entering the cylinder of an engine exhausting to the atmosphere finds the piston, cylinder cover, and port in contact with steam at a temperature of 300 degs. F., while no portion of the cylinder has been exposed to a temperature below 220 degs. F.

Again, steam entering the cylinder of an engine exhausting into a condenser finds the piston, cylinder cover, and ports in contact with steam of only 228 degs. F., while parts of the cylinder have been exposed to a temperature as low as 162 degs. F.

ployed. Suppose that between the boiler and each 48-inch cylinder of a reversing engine we place a 30-inch cylinder, into which the steam from the boiler is first admitted. With the simple engine, at the moment of reversal, the full boiler-pressure can be thrown on to the 48-inch piston, which has an area of 1810 square inches, but with the compound engine this pressure can be thrown only on to the 30-inch piston, which has an area of only 707 square inches. Consequently, the margin of power necessary for quick re-

versal is wanting. To ensure as prompt starting as in the case of the simple engine, the cylinders would need to be nearer 40 and 64 inches diameter, which would nearly double the cost of the engine and its maintenance.

Methods are in use for banking up the steam in the receiver between the high and low-pressure cylinders of a compound reversing engine for use at the moment of reversal, but such devices are not very effective. The economy of the compound over the simple reversing engine has not been very marked, and has been largely due to the fact that every time an engine is reversed a cylinder full of steam is thrown away. In a compound engine the steam from the low-pressure cylinder is wasted, but that from the high-pressure cylinder is caught and used up in the low-pressure. When the steam can be used up in this way in a turbine, the compound engine would not seem to afford a saving of steam sufficient to justify its additional cost and complication.

Steam Turbine Auxiliary.

While, therefore, it is not advisable to exhaust from a reversing engine direct to a condenser, the same objections do not apply to exhausting at about atmospheric pressure into a turbine, which can utilize this exhaust steam and itself discharge into a condenser, extracting from the exhaust steam about as much power as the engine has already got from the live steam. This becomes possible because the heat in the steam is the cause for, and the measure of its power to give out mechanical work; the energy from it being due and proportionate to the fall in temperature which occurs when steam is expanded in the engine, whether of the piston or turbine type.

Now steam at 120 lbs. boiler-pressure has a temperature of 350 degs. F., and if rejected by the piston engine at just over atmospheric pressure, or 230 degs. F., the engine cannot possibly convert into work more than 120 degs. fall in temperature. If this steam is then passed through a turbine which can further expand it down to the temperature of the condenser, which is about 130 degs. F., the turbine is then turning to account a further range of 100 degs., which otherwise would have to be wasted, because no piston engine can usefully expand steam much below five-sixths of atmospheric pressure. To do so, the pistons would have to be of impracticable size and cost, while the friction caused by them, together with the loss of heat when such enormous surfaces were subjected to wide variations in temperature, would neutralize any gain theoretically obtainable by such high grades of expansion.

The turbine, on the other hand, has only one rotating part carried in two bearings, so that the mechanical friction is very low, the flow of steam through it is always in one direction, and, therefore, there are no losses induced by alternate heating and cooling; there are no clearance spaces to be filled up, there are no reciprocating pieces to set up inertia or momentum stresses, and therefore the speed of the blades is not limited to a maximum of 1900, but may reach over 19,000 feet per minute. This materially reduces the size and cost of the apparatus.

Still, the turbine is not usually as efficient at high pressures as the piston engine. A well-fitted piston allows very little steam to pass it at any pressure, but the percentage of leakage through the clearance which must be left between the tips of the blades and the casing of a turbine is a serious matter at the high-pressure end, where the blades are short, though much less at the low-pressure end, where the blades are long and the pressure lower; hence the piston engine is most efficient at high pressures, but the turbine at those below the atmosphere, the combination comprising the best qualities of both types of prime mover. The exhaust turbine removes the only objection to the simple reversing engine, namely, its high steam consumption, but leaves its good qualities, its simplicity, and low first cost, its amenability to prompt handling and rapid increase of speed all unimpaired.

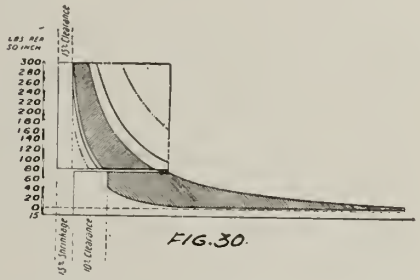


FIG. 30.

Indicator Diagram Records.

Figs. 1, 2, 5, 6, 9, 10, 13, 14, 17, 18, 21 and 22 are the indicator diagrams obtained from such an engine having a clearance space of 10 per cent. of the volume swept out by the piston—the smallest obtainable with piston valves—working with a pressure at the steam chest of 120 lbs. above the atmosphere, and with the steam cut off at various points of the stroke. The mean speed of the piston is 1,200 feet per minute, and the weight of the reciprocating parts 4¼ tons per cylinder—a fair average for such pieces. Figs. 1 to 10 are for the engine when non-condensing, and Figs. 13 to 22 when condensing.

To allow for the influence of the inertia and momentum of the reciprocating parts, the lines A B are drawn across each diagram; and are curved to allow for the irregularities in velocity introduced by a connecting rod of the common length—five times that of the crank. By taking the difference of pressures shown by the indicator to exist on the two sides of the piston, and deducting from this the height of the inertia curve when above, and adding the depth when below the line, there are obtained, the diagrams Figs. 3, 4, 7, 8, 11, 12, 15, 16, 19, 20, 23 and 24, shown cross-hatched below each indicator diagram.

These "equivalent" pressure" diagrams are most convenient. On them the resistance induced by inertia is subtracted from, and the assistance induced by momentum is added to, the force produced by the steam; then, by multiplying the "equivalent pressure" answering to any point in the piston's travel by the effective leverage of the crank at the same instant, the tangential twist actually exerted on the crank shaft is accurately known, whatever may be the position of the crank.

The above method is doubtless familiar to all making a serious study of the steam-engine, but it may be as well to point out how clearly this graphic method proves that the condenser, by reducing the pressure of the exhaust steam, impairs the cushion required to bring the piston and its attached parts quietly to rest. In Figs. 25 and 26 the equivalent diagrams, for a cut-off at one-sixth of the stroke when non-condensing, are superposed on the diagram when condensing, and the difference between them is cross-hatched. Instead of the pressure upon the crank pin decreasing, it increases towards the end of the stroke, more particularly on the return stroke, in which, owing to the angle of the connecting rod, the speed of the piston is greater during the fourth than it was during the third quadrant traversed by the crank pin. The motion of the piston of an engine exhausting into a condenser is that of the foot of a cyclist who stands on his pedals instead of reducing the pressure as his foot nears the bottom of the stroke.

The earlier in reason the steam can be cut off, the less of it will the engine use; but if the valve gear is so arranged that steam cannot be carried very far in the stroke, there must be many positions in which, when the engine is stopped, steam admitted to the steam-chest cannot find its way into the cylinder because the valves block the ports; or, if the steam can get in, the position of the crank is such that there is not sufficient purchase to turn the shaft around.

Two Crank Engine Example.

The case of an engine having two cranks set at an angle of 90 degs. from

each other is shown in Fig. 27. The upper part exhibits the effort which the steam can exert on the crank to start the engine from the state of rest in any position, with valves set to cut off at a maximum period of three-quarters of the stroke. In practice this is found the earliest point in the travel of the piston to which it is possible to limit the admission in an engine with only two cylinders, if such an engine is to start promptly. This allows a minimum starting effort of 190,000 foot-pounds in any position in which the engine may chance to stand.

Three Cylinder Engine Example.

Fig. 28 shows that if a third cylinder be added, and the cranks are spaced at an angle of 120 degs. apart, the valves may then be set to limit the admission to half stroke, and yet there will be an effort of 190,000 foot- pounds available for starting the engine. The saving in steam due to limiting the maximum cut-off to half instead of to three-quarters of the stroke, will be about 30 per cent. at the latest cut-off, when the consumption of steam is highest.

The turning moment of the three-cylinder when running is also much improved. At high speeds, when shocks are most detrimental, the variation between the maximum and the minimum turning efforts is as 2.2 is to 1 in the two-cylinder, but only as 1.5 is to 1 in the three-cylinder type. The running at slow speeds is also better, because the weight of the three cranks balance each other in any position, and there is none of that tendency to "hang" displayed by two-cylinder engines when both cranks come to the bottom.

With two cranks at right angles, the centre of gravity of the cranks, pins, and connecting rods is situated at a considerable distance outside the axis of the crank shaft; at high speeds this sets up a large unbalanced force tending to move the engine as a whole upon its foundations which must be massive to absorb the vibration. With three cranks spaced equally, there is no such unbalanced force tending to move the engine as a whole. True, both these defects of the two-cylinder engine can be counteracted by balance weights, but as these add considerably to the revolving weights, they make the engine more sluggish in starting and less prompt in stopping.

From every point of view, then, the three-cylinder engine is superior to the two-cylinder, and its very general adoption of recent years is not therefore surprising.

More Cylinders of Reduced Capacity.

Reversing engines, which are none too large to start quickly, all have such an excess of power when at full speed that, though the valve gear is linked up, the engines run away unless the steam is throttled down from boiler pressure, involving considerable loss by "wire drawing." On considering the defects of existing reversing engines, it occurred to the writer that by still further multiplying the number of cylinders and reducing their capacity, the starting effort could be increased, and the full boiler pressure utilized much later in the run, with a saving of steam both at commencement and finish.

Fig. 29 shows the working of an engine having five cylinders 36 inches diameter by 36 inches stroke, the combined capacity of which is 44 per cent. less than that of three cylinders 48 inches diameter by 60 inches stroke, and 15 per cent. less than that of the two-cylinder engine of that size. The minimum starting effort of the 5-cylinder engine is 42 per cent. greater than that of the three, and 37 per cent. greater than that of the two-cylinder engines with larger cylinders.

Apart, however, from the saving in steam which this would effect, the shorter stroke of the five-cylinder engine would permit of its being run at 200 revolutions, without exceeding the piston speed of the larger engines, running at 120 revolutions, so enabling a larger output to be obtained from the mill. Also, the turning moment obtained from the five-cylinder engine, as shown in Fig. 29, is so nearly constant that the maximum stress on the crankshaft, the spindles, and rolls is 25 per cent. less than with the two-cylinder, and 29 per cent. lower than with the three-cylinder engines. The cranks also balance each other against gravity in any position, just as in the case of a three-cylinder engine; so that there are no unbalanced forces tending to move the engine as a whole on its foundations, and the local unbalanced force may be materially reduced. By placing the two adjoining cranks, not at 72 degs. apart, but at 144 degs., the weights concentrated at the crank pins go a long way towards balancing each other, the disturbing couple being situated at a distance of only 5.56 inches from the centre of the crank-shaft, whereas in the three-cylinder engine the couple tending to shake the bearing between the two cranks will be situated at 15 inches from the axis of the shaft; and as the centrifugal force is proportional to the square of the speed, the disturbing force, at the same number of revolutions, with the five-cylinder engine will be as 31 to 225 in the case of the three-cylinder engine—only about one-seventh as great—supposing the weights for both engines were alike, whereas the connecting rods of the five-cylinder would be appreciably lighter. In addition to these advantages, the first cost of five engines with cylinders 36 inches diameter by 3 feet stroke would not be more than about three-fourths of that of three engines having cylinders 48 inches diameter by 5 feet stroke.

The cost of the spare parts to be kept in stock in case of a breakdown would also be reduced by about one-half; and if the five sections of the crank-shaft were made all precisely alike, as could be easily arranged, only one-fifth of a crank-shaft would be needed to insure immunity against having to wait while a new crank-shaft was being made to replace a broken one. Indeed, there would probably be very little difficulty in running with four cylinders only for some considerable period if desired.

The most marked advantage, however, would be in the case of a plant containing cogging, roughing, and finishing mills. In this case, the keeping in stock of a complete spare engine, even down to the cylinder and bed plate to renew any one broken would only add one-fifteenth to the whole cost of the three sets of engines, and by making the parts interchangeable a damaged engine could be literally lifted out and a new one dropped in its place without stopping the plant for more than a few days.

Steam Pressure Feature.

There is one further point to deal with, namely, the steam pressure. The higher the pressure against which the engine exhausts, the more effiicent is the cushion. There seems no reason why the common pressure of 120 lbs. should not be materially increased, now that water-tube boilers are available. The writer has had several engines, for the design of which he is responsible, working for some years now with steam of 200 lbs. pressure superheated 150 degs. F., and has experienced no trouble whatever with them. Pressures of 250 and 265 lbs. have long been common in the navy; and there seems no reason whatever why steam of 300 lbs. pressure, superheated 150 degs. F., up to which temperature no difficulties arise, should not be regularly used in reversing engines.

Fig. 30 shows the theoretical diagrams worked out for a reversing engine with a clearance space of 15 per cent., starting with a boiler pressure of 300 lbs. and exhausting against a pressure of 80 lbs.; then, allowing for a loss of 15 per cent. in transfer, this steam is shown expanded down in an engine having a clearance space of 10 per cent. (easily obtainable when engines are not required to reverse) expanded three and one half fold, and exhausted at 17.5 lbs. absolute,

after which it would be expanded down again in an exhaust turbine.

Consider the case of blast furnaces consuming 50 tons of coke per hour, and yielding 140,000 cubic feet of gas per ton of coke; the gas given would be 7,000,000 cubic feet. Allowing 45 per cent. of this for heating the stoves there would remain for producing power 3,850,000 cubic feet of gas per hour. Employing this gas to raise steam at 300 lbs. pressure, superheated 150 degs. F. in boilers capable of evaporating 50 lbs. of water per 1,000 feet of gas, there would be available 192,500 lbs. of steam per hour.

This steam taken direct to reversing engines in the mill, requiring 30 lbs. of steam per indicated horse-power when exhausting against a pressure of 80 lbs. per square inch, would afford a continuous output of 6,416 indicated horsepower hours.

Allowing that this exhaust steam would lose 15 per cent. in weight by condensation, etc., and drop 5 lbs. in pressure, there would be left 163,625 lbs. of steam at 75 lbs. pressure to supply blast. Engines worked by this steam, which would yield one indicated horsepower for every 31 lbs. of steam when discharging at a little above atmospheric pressure, would provide 5,278 indicated horsepower for blowing the blast furnaces. The blast required would be about 4,875,000 cubic feet per hour, or 81,250 cubic feet of free air per minute, to compress which to 8 lbs. pressure per square inch would require about 32½ nett indicated horsepower per 100 cubic feet, or 2,641 indicated horsepower. Blowing engines having a mechanical efficiency of 85 per cent. and a volumetric efficiency of 90 per cent. (giving an over all efficiency of 76½ per cent.) would absorb in this work 3,452 indicated horsepower, leaving a margin of 1,826 indicated horsepower to meet contingencies.

Deducting 5 per cent. leaves 155,444 lbs. of exhaust steam from these engines, which would produce in an exhaust turbine capable of generating one electrical horsepower for 30 lbs. of steam, 5181 electrical horsepower for the supply of current for the various purposes for which power is required about a works. Seeing there would be only one set of boilers and one set of condensing plant for the three departments—the blast furnaces, rolling mills and general electric supply—while all the engines would be of simple pattern, the first cost of such plant would be extremely moderate and the working costs very low.

It may be interesting to compare this proposed method of working with that of doing the same work by gas engines, taking 1,000 cubic feet of gas to produce 11½ indicated horsepower. The gas blowing engines, to be capable of producing the same power as before, namely, 5,278 indicated horsepower, would require 458,956 cubic feet of gas; to provide electric current equal to 5,181 horsepower, would require 7,200 indicated horsepower, consuming 626,087 cubic feet of gas; and taking the overall efficiency of an Ilgner set at full load at 60 per cent., or say 55 per cent. average, there would be required 11,665 indicated horsepower to drive the mills; consuming a further 1,014,434 feet of gas, making in all a total of 2,099,479 cubic feet. This would leave a surplus of 1,750,521 feet of gas available for some other purpose.

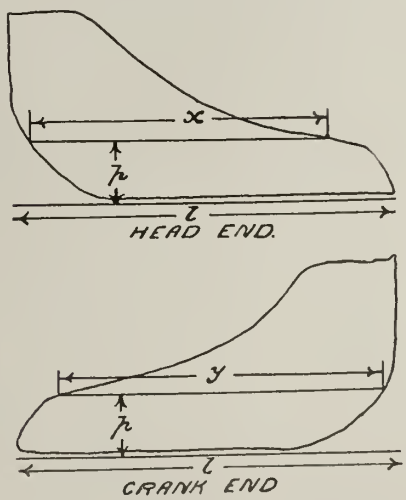
Against this, however, would have to be set the interest, depreciation, and wear and tear of the gas cleaning and electric plant and gas engines, and the higher amount of wages necessary to clean, work and tend them.

Which of the two system would, on the whole, be the cheaper to run would depend upon the price obtainable for the surplus power.

TO COMPUTE STEAM CONSUMPTION FROM INDICATOR DIAGRAMS.

By Joseph W. Hayward, M.Sc.

THE simple method of estimating the steam consumption of an engine from indicator diagrams given below, though rough and ready, is of considerable use. At least the present writer has found it so, and he knows of an instance in which its application led to the discovery of serious leakage past the high pressure valve of a compound engine. This computation gives the quantity of steam actually being used in each cylinder of an engine, and upon each side of the piston. To get the corresponding boiler feed, an allowance of about 10 per cent. must be added to the figures obtained to allow for condensation in steam pipes and engine. In other words, should the boiler feed exceed the diagram computation by much more than ten per cent., something is wrong, and a leakage should be sought for. Again, in a compound engine, if more steam appears in the low pressure than in the high pressure cylinder, there must be a leakage past the high pressure valve or piston, and if there is more in the high than the low, the leak must be upon the low pressure side.



Steam Consumption from Indicator Diagrams.

Necessary Data and Constructional Detail.

The necessary data for the computation are a pair of indicator diagrams from the "head" and "crank" ends of the cylinder, and the following notation of other particulars:—

A. = area of piston in square feet.
a = area of piston rod in square feet.
L = stroke of piston in feet.
N = revolutions per minute.

Draw lines across the diagrams corresponding to any convenient pressure (p), and cutting both the expansion and compression curves. The lengths of these lines (x) and (y) represent the volumes of steam used and discharged while the diagrams were being drawn, upon the same scale of which (l), the length of diagram, represents the volume swept out by the piston; (i.e. AL for the head end, and (A—a) L for the crank end.) This volume of steam is the difference between the total volume in the cylinder during expansion and the volume retained during compression, both measured at the particular pressure (p).

It follows that the volume of steam discharged per revolution, measured at pressure (p) is

$\frac{x}{l}$. AL cubic feet for the head end,

and $\frac{y}{l}$ (A — a) l cubic feet for the crank end.

The total volume discharged per revolution is, therefore:

$$\frac{x}{l} AL + \frac{y}{l} (A - a) L = \frac{L}{l} [xA + y (A - a)],$$

and the consumption per hour is $\frac{60\ NL}{l}$ [xA + y (A — a)] cubic feet. The volume (V) of one pound of saturated steam at pressure (p) may be found by reference to a set of steam tables.

The weight of steam consumed per hour by the engine is the volume at pres-

sure (p) found above, divided by (V),

and $= \frac{60\ NL}{Vl} [xA + y\ (A - a)]$ pounds per hour.

Example.

The diagrams given are from a 12 by 16-inch engine (with a 3-inch piston rod), making 180 revolutions per minute.

$L = \frac{4}{3}$ feet.

$A = .785$ square feet.

$a = .049$ square feet.

$N = 180$.

$L = 3$ inches.

$x = 2.3$ inches.

$y = 2.5$ inches.

$p = 30$ lbs. per square inch above atmosphere $= 45$ lbs. absolute, approximately. Therefore, $V = 9.287$ cubic feet.

$$\frac{60\ NL}{VL} [xA + y\ (A - a)] =$$

$$\frac{60 \times 180 \times 4}{9.287 \times 3 \times 3} [2.3 \times .785 + 2.5 \times .736]$$

$= 1884$ lbs. per hour, and adding 10 per cent., this becomes 2,072 lbs.

The horsepower of the engine, deduced from the indicator diagrams is 75, therefore this computation shows the feed water consumption to be approximately 27.6 lbs. per horsepower-hour.

LIQUID FUEL.

FOR power purposes and industrial operations, liquid fuel has of late been widely and effectively utilized. Brought into larger prominence, as it was, by the incidence of the recent coal strike in England, it soon became recognized as a good substitute for coal. Again, from an economical standpoint, liquid fuel is cheaper than solid fuel. Messrs. Kermode's, Ltd., Liverpool, have done much in the propagation of the merits and utility of liquid fuel. This firm has devoted the closest attention to the perfection of liquid fuel, and their systems have been adopted in many directions. They have issued a pamphlet, dealing with the employment of liquid fuel, which is replete with excellent illustrations of plants equipped for its consumption, including boilers of the Yarrow, Babcock & Wilcox, vertical, marine, multitubular, Lancashire, and watertube types. Motor fire engines and other vehicles are also shown equipped in this manner. There is also included in the pamphlet a description of the Kermode burners.

Comparison With Coal.

In the course of an article from "The Steamship," which prefaces the book, it is stated that economic compensations offered by liquid fuel are so many that a higher price can be allowed, and in very many cases there is no excess of actual money cost against it. Coal is, under any conditions, a dirty, wasteful, and variable means of raising steam and providing power. Its quality varies so enormously that its wastefulness is not always appreciated to its full extent. There are a number of constituents which are not at all necessary to the provision of heat and which are injurious to boilers and furnaces, and harmful to individuals working them. Coal is costly to handle, and entails a lot of unnecessary work in use. The vast difference between liquid fuel and coal is graphically seen in the storage of each. It is typical of the two descriptions of fuel —one the embodiment of clumsiness and uncleanliness, the other clean, easy, and efficient.

With such a vital thing as fuel—the basis of all trade industry and commerce—the change from coal to oil fuel may be slow, though it need not be conservative, and with a wider knowledge of the many advantages which the use of liquid fuel offers, especially in industrial process work, we may look for its wider adoption and for many improvements in the design of boilers and industrial furnaces to ensure the best results. The sources of supply are every day becoming greater in number, and several oil companies are making extensive arrangements to facilitate cheap transport, ample storage, and fair prices to meet the undoubted growing demand for the commodity.

Success of Liquid Fuel.

Liquid fuel now plays an important part in meeting the present needs of naval ships. In 1902, Mr. Kermode had the honor of demonstrating for the British Admiralty the successful application of oil fuel for the use of torpedo-boat destroyers, and Great Britain now possesses many vessels of this type which are fired exclusively with oil fuel. The adoption of oil fuel for naval requirements not only reduces the personnel of each ship, but it renders what was formerly the hardest work on board ship light and easy. It adds to the speed of the ship, and the smoke column by day and the pillar of fire by night which characterizes the coal-fired torpedo boat, has disappeared, with the result that the movements of these vessels are rendered more difficult of detection, which is a most important feature in war time.

What is true of marine success with liquid fuel is equally so in stationary plants, and we are of the opinion that the day is not far distant when, due to its larger adoption in the latter, perhaps even greater achievements will result.

OIL FUEL IN A SHIPYARD.

TO be independent of coal four large boilers at Harland & Wolff's shipyard, Queens Island, Belfast, Ireland, have been adapted for oil fuel. Using coal for fuel, one of these boilers evaporates 16,000 lb. of water an hour, and the other three 12,000 lb. each. With liquid fuel they will generate 4,000 H.P. per hour. The work of installation is so simple that it can be carried on without letting the steam out of the boilers. The steam-jet arrangement is used. The oil enters the boiler through a branch pipe and is given a whirling motion by the prolonged spiral stem of the valve spindle; the amount of oil being governed by a handwheel at the end of the spindle. The steam enters at another valve and passes through slots in the cylindrical part of the cone. All the oil passing through the burner is thus steam jacketed. One or two men can attend to a dozen boilers burning liquid fuel.

MALLET TYPE LOCOMOTIVES.

ACCORDING to the Railway Gazette there are at present something like 500 locomotives of the Mallet type in service on the different railways in the United States, Canada and Mexico. These include practically all possible wheel arrangements and boiler designs, and, speaking in a general sense, they are working under similar conditions. While it is impossible to obtain in any considerable number of cases, the cost in money of both the Mallets and the types they have replaced, it is yet possible to glean facts concerning the majority of the locomotives in service, which permit fair conclusions being drawn as to the relative value of different types.

Mallet locomotives have in very many cases taken the place of 2-8-0 engines, and the investigation has proved that the former haul from 21 per cent, to 92 per cent. greater loads than the latter, and, in fact, that two of them will do the work for which three "Consolidations" are ordinarily needed. It is nearly on this ratio that the number of engines has been reduced on some lines. The mere reduction in the number of trains on the road, even though they be longer and heavier, introduces a very large saving from every standpoint, and one which it is difficult to estimate accurately. There is, of course, the reduction in wages of engine and train crews, and as regards fuel consumption the Mallets show an average saving of 3 lb. per 100 ton-miles.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. V. JUNE, 1912 No. 6

POWER PLANT INSPECTION AND INSURANCE

INSURANCE of the power plant against accident, disastrous or otherwise may be considered as the supplement of its efficient and sufficient inspection and survey. Without the latter, the protection provision for our power equipment mechanisms is somewhat on a par with life insurance; the end being inevitable. We are of opinion, that just here an insufficient realization of the subject of plant inspection and insurance exists in the minds of those whose privilege it is to make the decision. Life insurance, as has been said is a provision against the inevitable, but insurance of the plant is not necessarily, and seldom materializes as a compensation against the like contingency. Records of recent years go to show blow-up of boilers, broken cylinder heads, bursting steam pipes, burnt-out electrical equipment, to be such rare occurrences that the payment of insurance premiums is more or less of a luxury which can be dispensed with. The intelligent operation of a plant whose manufacture and installation is the work of reputable firms seems the most desirable and effective premium with which to insure against explosion, breakdown, etc., and in the exercise of this feature, there should be noted, in very essence, the question of inspection.

Judged by the casualty returns of the Dominion, it would be concluded that one or other, or a combination of intelligent operation, expert inspection and direction, reliable manufacture and installation, and, may we add, the providential and miraculous, have conspired to bring about the existent highly satisfactory conditions. Insurance, pure and unadulterated, has not, will not and cannot produce the record of freedom from disaster in power plants to which we have been accustomed. Intelligent operation is, however, a contributory cause, and whether expert inspection and direction form a part of the plant equipment or not, it should exist, be developed and encouraged. Competition is now so keen and the desire to excel is so strong and widely prevalent that manufacture and installation of equipment leave little to be desired; therefore, to the good record must be credited each of these circumstances. Concerning the providential and miraculous feature, we are afraid that time long or short will blot the fair page, for even should the manufacture and installation be of the highest grade that engineering skill can produce, and intelligent care and operation be absent, the day of disaster becomes pressingly imminent.

An important consideration to be noted is that of the day by day efficiency and economy of the plant, and we are inclined to think that many owners of equipment quite overlook this. Insurance effected is taken for granted to compensate the loss arising from a boiler bursting, or some such equally big smash-up, yet no thought is given to the numerous hourly losses, due to inattention on the part of the management to the wants of and suggestions by the operators for betterment; to the carelessness and, maybe, ignorance of the latter; and all largely because of smug satisfaction with an insurance in force. The cost involved in acceding to an intelligent operator's request, or the money saved by keeping a roustabout in charge, and the payment of a small premium as a protection against a disaster which everyone sincerely hopes will never happen, are each aiders and abettors in accelerating and ultimately bringing about undesirable results. If protection is wanted, let it be a double-header — inspection and insurance, even although it costs more, as it should. Capable and expert inspection means putting at your disposal and service high paid and reliable personal oversight of the plant with respect to daily efficient and economical operation, and this after all should be the prime and main consideration. As already stated, the cost comes high comparatively, but in most cases none too high to make the venture a paying investment.

Naturally a big outlay for inspection purposes encourages the idea that large savings are going to be effected, yet results may or may not be as anticipated. If the former materialize, we are happy, and due to their steady maintenance it is just possible we come to believe that continued inspection may be cut out. If no tangible savings are apparent we begin to doubt the wisdom of the proceding and, as in the case of the other, conclude that it is not worth while. We lose sight of the fact that achievement has to be maintained and that a highly satisfactory operating condition exists in each respectively, and, further, that wisdom or business acumen demands our persistence in the practice of the good work. The all-too-common tendency to call in the services of an "unknown," so far as record is concerned, is to be deprecated, because in matters so important as power plant efficiency, reliability and economy, no chances should be and may not be taken. It is always possible for a fee of from one to five dollars to have an "ineapable" inspect your equipment once a year, but it is highly probable the proceeding will eventually contribute to sleepless nights and a depleted bank account. Inspection and insurance worthy the name should be practiced by every power plant owner, no matter how small the installation be, and its complement—the employment of reliable and qualified operators is just as important. Further, the best of each available should be procured, irrespective of cost.

Cost Accounting in Relation to Industrial Power*

By J. W. Helps, Toronto

No more prominent feature, and one to be found in every department and sphere of business management, can be pointed out than that of cost accounting; it having been clearly recognized, that only by a true application of the latter can the keen competition of commercial life be successfully negotiated to-day. Not the least important section is that of power cost accounting. A careful perusal of the paper will serve to guide those interested and affected to secure a better, perhaps more reliable and more complete understanding of the subject.

ASSUMING that we have made up our costs for a year, it becomes necessary to clearly define to what these really refer, for it must be admitted that many engineers do not actually know their real disposition. To say you are running a 200-horsepower engine for ten hours daily on a steady load is not sufficient, for, as a matter of fact, it is saying something which is neither intelligent nor useful. We have to find the actual work we are doing, and this is got by ascertaining:—

First.—The maximum demand on engine.

Second.—The actual output in horsepower hours or kilowatt hours.

Maximum Demand Feature.

The first item should be obtained either by installing a graphic recording meter, if electrical distribution is made use of, or by frequent tests if mechanical distribution only is applied, and will be entirely independent of the size of the engine. Then, if we take our total fixed charges and divide by the number of horsepower of maximum demand we get our annual cost per horsepower per year in fixed charges. This in practice is found to come anywhere from $15.00 to $27.00 per horsepower of actual maximum demand.

It is interesting to note the curious difficulty some people experience in grasping the meaning of the term "maximum demand." For instance, here is a mill operating a large number of small motors, ranging from 3 to 35 horsepower. They are all carefully selected to meet actual requirements, e.g., the 35 horsepower motors are connected to machines which actually require 35 horsepower, and there is no instance of overmotoring to any noticeable extent. The combined horsepower is 525. Now, what will the maximum load be? Fig. 4 gives the load curve on this installation as shown on a graphic recording meter and here we see what the maximum actually is—260 horsepower.

Suppose that the fixed charges in this instance amount to $312. If we followed the erroneous method all too frequently taken, we would say that represented $312.00÷525=59 cents per horsepower, while actually it should be $312.00÷260=$1.20 per horsepower, because the only real and sensible basis is the actual maximum demand. Many an engine which is rightly rated as 200 horsepower will be found to be carrying a maximum demand of only 50 or 60 per cent. of that horsepower.

To what extent is the maximum horsepower employed? By "load factor" we usually mean the ratio of the average load to the maximum demand, over a given time. This will vary with differ-

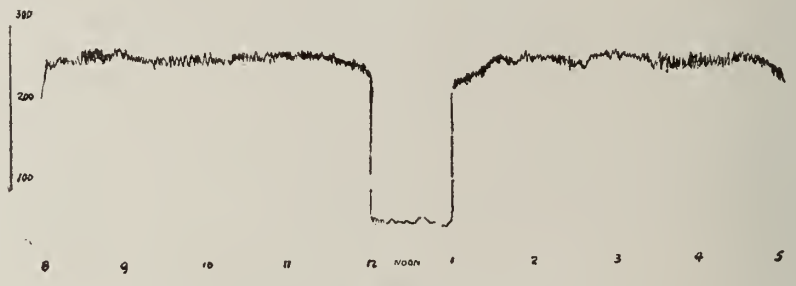


Fig. 4—Connected load, 525 h.p. Maximum demand, 260 h.p.

*Conclusion of abstract of paper read before the Central Railway and Engineering Club, Toronto, April, 1912.

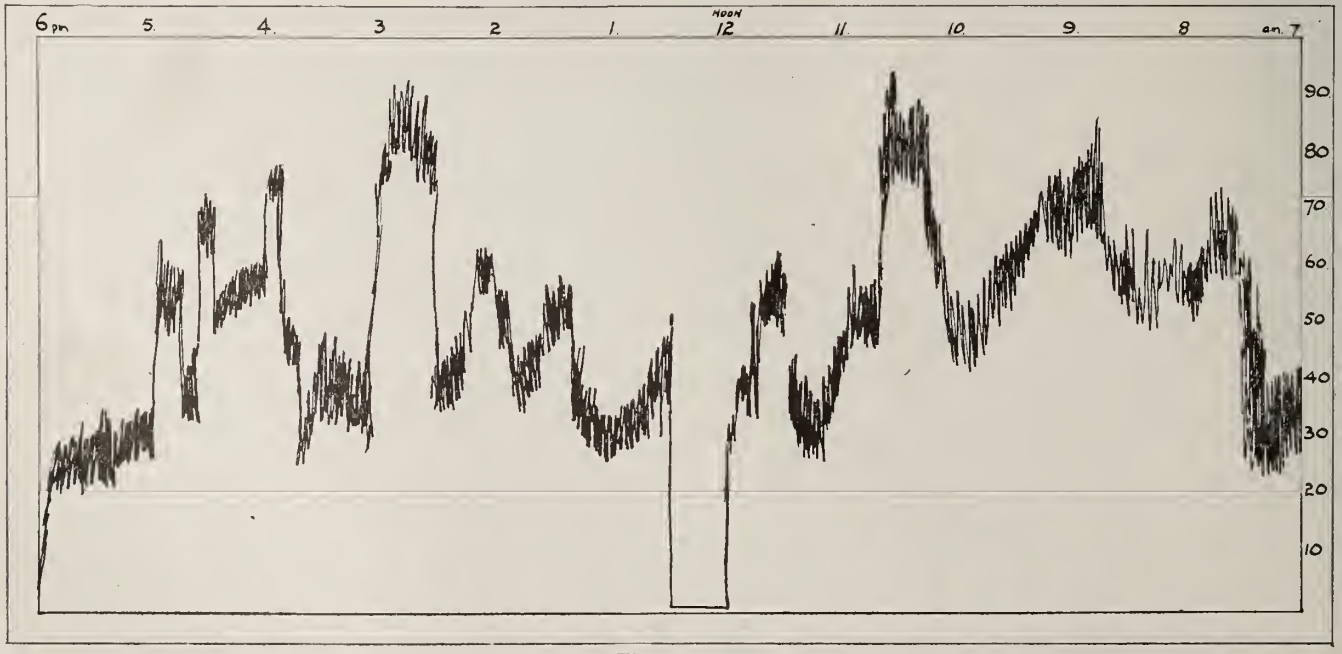


Fig. 3.

ent classes of manufacture, which the average results in a few instances will serve to illustrate; each case being taken on the basis of ten hours daily.

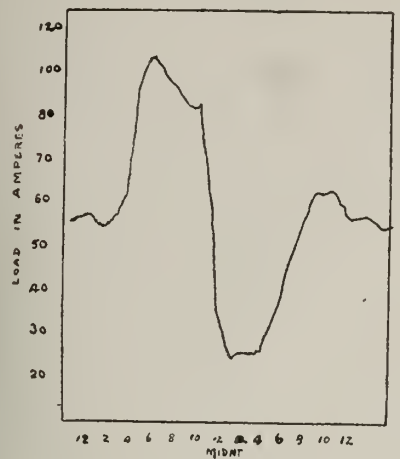


Fig. 6—Typical hotel curve.

Load Factor Averages.

	Per cent.
Cement mills	80
Textile mills (cotton and woolen)	65
Tanneries	45
Ice machines	53
Refrigerators	60 to 85
Flour mills	50
Machine shop	35 to 45
Boiler shop	25 to 30
Soap manufacture	28 to 35
Wood working (carpenter shops)	10 to 25
Planing mills	20 to 30

Thus, a flour mill having a maximum demand of—say 180 horsepower, and running for 200 hours per month, will have used approximately 180×200÷2=18,000 horsepower hours. Assuming that our fixed charges on the plant amount to $3,240.00, which is equivalent to $1.50 per horsepower of maximum demand on a monthly basis, then our fixed charges for the month are $180×1½=$270.00. Our operating costs have totaled, say—$225.00 or 1¼ cents per horsepower hour. The total cost then becomes 270+225=$495.00, and this divided into horsepower bours will be 49,500÷18,000 or 2.75 cents per horsepower hour.

This reckoning would look strange to a man who described his 250 horsepower plant as having "a steady 10-hour full load," for his engine was set down as 250 horsepower and the fixed charges were divided by that amount, $3,240÷250=$12.95 per horsepower year, or $1.08 per horsepower montb.

The monthly operating costs were set out as 250×200=50,000 horsepower hours, and the operating cost, $225.00, divided by this amount equals 0.45 cents per horsepower hour. The annual running cost per horsepower was then said to be:—

Fixed charges	$12.95
Operating costs	10.80
Cost per horsepower per year	$23.75

Tbe actual cost was at the rate of $33.00 per horsepower per year, because it was the total cost divided by 180, and not by 250, and the actual horsepower hours developed monthly amounted to $\frac{200\times180}{.50}$=18,000 and not 200×250=50,000.

Of course the load curve is not often so even as that shown in Fig. 4. A very different condition is shown on Figs. 3-5, whilst a typical hotel curve is shown on Fig. 6, that of a jute mill in Fig. 7, and of a foundry in Fig. 8. Fig. 9 is the load curve of a large railway station in Ontario and Fig. 3 of a leather goods factory in Toronto. Note tbe great disparity between the average load and the maximum demand!

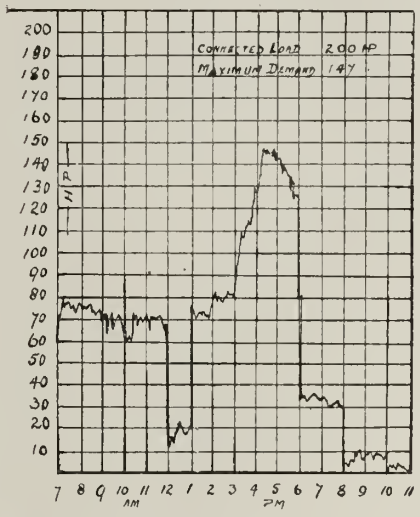


Fig. 8—Connected load, 200 h.p. Maximum demand, 147 h.p.

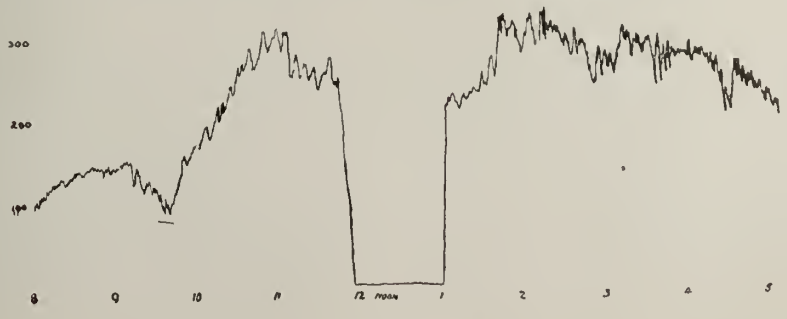


Fig. 5—Connected load, 400 h.p. Maximum demand, 340 h.p.

Actual Output.

The actual output must be taken in every case, but not the gross output

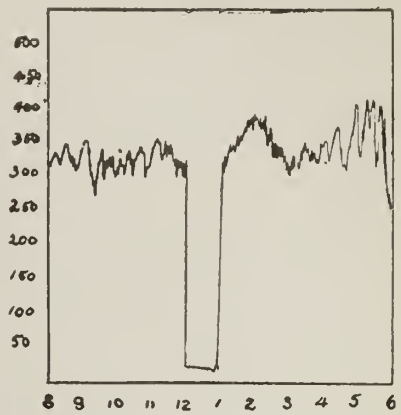


Fig. 7—Connected load, 500 h.p. Maximum demand, 420 h.p.

from the engine, for this is not the power used in doing work. We must deduct from the results shown by actual engine test all losses between it and the machinery to be driven. Thus, in an electrical distribution, there are the losses in generator, leads and motor, and in a mechanical distribntion, tbe friction losses in belts, pulleys and shafting. In each case, there is also the actual engine loss.

The question of the allowance to be made for exhaust steam used—say, for heating a building, is too complex to be taken up here, therefore, I would merely suggest the right basis upon which to calculate this. Find out what would be the cost of fuel for heating with a properly devised heating plant, and deduct this from the cost of your steam power. It is a fallacy to suppose that because you get 90 per cent. of the heat content in the steam from tbe exhaust you must credit the boilers with that 90 per cent. in favor of your steam power. The accompanying chart (Fig. 10) shows the relation between the coal bill and temperature in heating a large building in Toronto, the upper line showing the mean temperature for the month and the lower line the coal consumption. It will be obvious then, that if the exhaust steam is sufficient in the coldest weather, it will be more than sufficient during all other times, and just as you can't use all of the steam heat in your engine, neither can you in your radiators. The subject of this paper, however, is not exhaust steam versus live steam. It is only intended to suggest the main lines along which we may arrive at a proper method of costing.

One thing remains to be touched upon —that under ordinary conditions, the

cost per horsepower varies with the number of hours during which the plant is operated, and if the foregoing has not made that clear, a brief study of figures 1—2, should do so. Thus, the same power, which will cost 4¼ cents per horsepower hour on 100 hours monthly use of the maximum demand, will only cost 2¾ cents per horsepower hour, when the amount of use is doubled. This explains why so-called "flat rates" for power are rapidly and justly going into the wastepaper basket.

My remarks are intended to be introductory, rather than exhaustive, but let us hope that we may find in them something which shall help us to get a better grasp of our conditions. In the past, men talked price "per k.w.h." or "per h.p. per year," but as we have to live in the present and the future, let us seek to in every way improve. Cheap power is everything to-day, and it is our duty to try to obtain it.

The Canadian Rand Co., Ltd., of Montreal, have changed their name to the Canadian Ingersoll-Rand Co., Ltd. The change is one of name only, the company being prepared to supply all apparatus and machinery as heretofore.

NOTES ON STEAM BOILER EFFICIENCY*

By Edward A. Uehling.

THE best average boiler efficiency fifty years ago was probably close on to 60 per cent; 25 years ago it was about 60 per cent., and to-day the average boiler efficiency still hangs close to 60 per cent. Thus, while the steam engine has been so improved that a given amount of steam will produce nearly three times the power obtainable 50 years ago, the steam boiler continues to waste 40 per cent. of the heat energy contained in the fuel. There are several reasons why this is so:

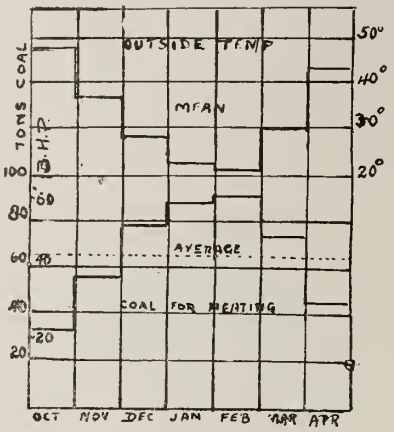


Fig. 10.

Comparison of Engine and Boiler Progress.

To begin with, the steam boiler (including its setting) because of the simplicity of its function, had been developed into a far more perfect apparatus for the purpose of generating steam 50 years ago than was the steam engine of that time. Later, however, thorough investigations of the properties of steam were carried on by scientists, who formulated the laws of expansion, thereby not only revealing the great wastefulness of the then existing steam engine, but at the same time pointing out the upper limits possible to attain. Based on these revelations of science, inventive genius and mechanical skill, in combination with practical experience, wrought the great improvements embodied in the many types of engines of to-day, including the steam turbine.

The principal reason for the slow progress in the economical operation of the steam boiler is due largely to the fact that it is of necessity a rough and uncouth apparatus, placed in dirty, dingy surroundings and generally indifferent and often inadequately housed. Brawn and muscle are considered the principal requirements in a boiler attendant. As a rule, neither compensation nor environment is calculated to attract the more intelligent from among the men available, and perhaps there is not one fireman in a thousand who has any concep-

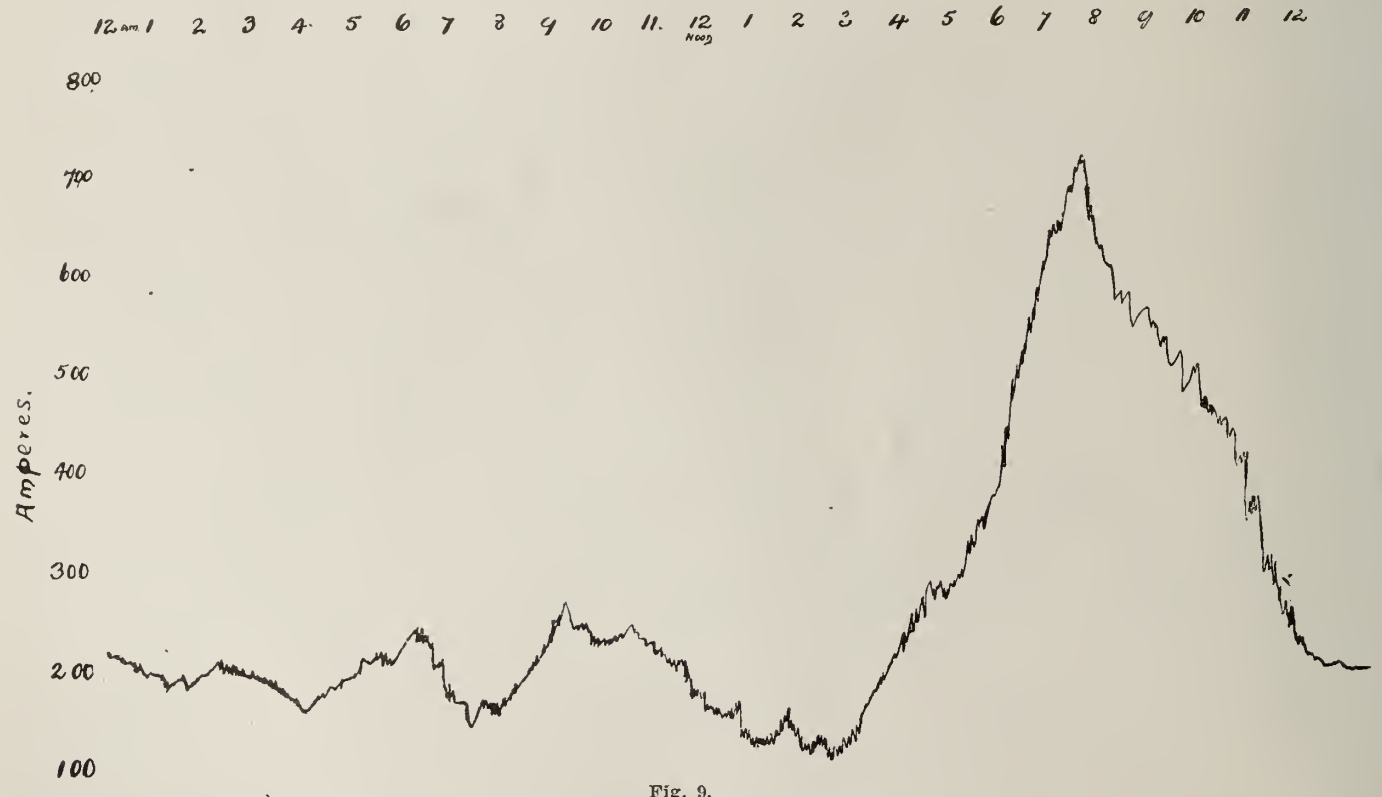


Fig. 9.

Mr. W. Almon Hare, B.A. Sc., president the Hare Engineering Co., Ltd., Toronto, has left for England and the Continent on a business trip and will be absent about six or seven weeks.

*Abstract of paper read before the Master Mechanics' Association of America, at Boston, April, 1912.

tion of the chemical reactions that constitute the process of combustion.

The steam engine, on the other hand, is a highly finished machine, housed in well lighted and well appointed quarters, therefore commanding and receiving close attention. Furthermore, it is attended by high class men, trained by education and long experience, who understand its mechanism and mode of operation. Again, in the steam engine, although it is a complex mechanism as compared with the steam boiler, the regulations and adjustments necessary to maintain maximum efficiency are exceedingly simple in comparison to what is required to attain and maintain the highest boiler efficiency. A steam engine correctly designed and properly constructed, accurately adjusted and adapted to the work to be performed, will give maximum economy. The speed is uniform and the steam used is automatically regulated to suit the load. Certain definitely fixed and automatic adjustments have been found to give maximum efficiency; the attendant, therefore, has only to maintain these adjustments to insure efficiency.

Boiler Efficiency Considerations.

The efficiency of the steam generator depends on far more complex conditions, many of which are not only beyond control, but are continually changing. Included are atmospheric conditions, quality of fuel, the condition of the boiler as to setting, dirty heating surface, air infiltration, draft, etc. The grates become choked with slate and clinker, obstructing the air passages and causing irregular flow, resulting in a deficiency of air in one place and an excess in another. Every one of these variables affect the efficiency of the boiler furnace. Furthermore, the required output, which varies in some plants between very wide limits, is an important factor.

One is, therefore, forced to the conclusion that the lack of progress in boiler efficiency under actual operating conditions is not due to any want of improvement in design and construction of the present-day boiler and setting, but that it is due almost entirely to insufficient knowledge of the conditions involved and consequent wasteful manipulation.

Operation Largely at Fault.

That this is true is proved by the fact that almost invariably official boiler tests made by or under the direct supervision of experts, show from 10 to 20 per cent. greater efficiency than is obtained from the same boilers in everyday practice. This raises the question, can the high efficiency obtained by an expert be at least approximately maintained in everyday practice? If so, how can it be accomplished? What does the expert do to get his results?

Expert Test Producers.

He analyzes the coal for the purpose of ascertaining its heat value, and to find out how to burn it effectively. He brings with him one or more expert firemen or selects the best available from the existing staff, and generally pays them extra to insure good work. He makes sure that the boiler is clean, inside and out, that the grate bars are whole and straight and suitable for the kind of coal to be burned. He sees to it that there are no cracks and crevices in the boiler wells and that the cleaning doors are closed tight.

He is also assisted by a staff of trained observers. One keeps a careful record of the weight of coal fired; another accurately weighs or measures the feed water; a third analyzes the flue gas and notes its temperature, while the fourth ascertains the quality of the steam. Much other data is noted and recorded, all of which is necessary to enable the expert to calculate the efficiency of the boiler under test and to strike a heat balance. With the exception, however, of those appertaining to the composition and temperature of the flue gas, none of the data noted and recorded by the staff of assistants is of the least aid in attaining high efficiency; and since the two essential elements in the flue gas records, CO_2 and temperature, can be autographically recorded and continuously indicated by appliances readily available at reasonable cost, an expert and a corps of assistants are not required to assure economic boiler operation in everday practice.

Essentials in Boiler Testing.

Sifting the essentials from the non-essentials in the program of the expert boiler testing, there are:—

(1)—Clean boilers; (2)—tight settings; (3)—skilful firing; (4)—knowledge of the chemical composition and physical properties of the coal used; (5)—furnace adapted to the fuel; (6)—draft regulation; (7)—continuous knowledge of the percentage of CO_2 contained in the flue gas, also its temperature at the point where it leaves the boiler.

The first five of these conditions essential to boiler efficiency should be quite self-evident.

1.—As to clean boilers, it should not require the services of an expert to keep the boilers clean, yet a great deal of coal is wasted because of dirty and scaly heating surfaces.

2.—Tight boiler settings are the exception rather than the rule. Should an expert and a staff of assistants be required to keep the settings tight? Certainly not. It is nevertheless a deplorable fact that air infiltration is one of the most prolific causes of low boiler efficiency.

3.—Every material change in the chemical and physical property of the coal requires a change in the method of firing, the frequency of cleaning the fire, the strength of draft, etc. A correct knowledge of the chemical composition and physical properties of coal used will, therefore, be of material assistance in maintaining high efficiency in everyday practice.

4.—Regarding the furnace and grate bars, every steam engineer of experience knows that they must be adapted to the kind of coal available if good results are to be realized. It may and generally does require the service of a combustion expert to determine the grate and furnace construction best adapted to burning a given fuel; but when these conditions are once established there is no good reason why they should not be maintained.

5.—Draft regulation is one of the most important factors and probably the least understood. Draft, whether natural, forced or induced, is manifested by a difference in pressure. The effective draft is the difference in pressure between the air under the grate bars and that at the point of leaving the boiler. It may be considered as divided into two parts, namely, the furnace draft and the boiler draft. The former is the pressure difference between the ashpit and the furnace, and the latter is the pressure difference between the furnace and the uptake. The boiler draft varies directly with the volume of gas coming from the furnace; hence for the same rate of combustion it varies inversely as the percentage of CO_2 in the flue gas, and for the same percentage of CO_2 it varies directly as the rate of combustion. The furnace draft depends on many things:—the kind of coal, the rate of driving, the thickness of the fire, and its condition, the formation of clinker, etc,; from all of which it is evident that the proper regulation of the draft requires close and intelligent observation and judgment.

6. Skilful firing and intelligent manipulation are therefore prime requisites in the economic operation of steam boilers, and that is why the exeprt, when he is conducting an efficiency test, is so particular in selecting his firemen. To overcome any errors in judgment on the part of the firemen, he resorts to analyzing the flue gases, which is the only correct and adequate method of controlling the process of combustion.

Combustion Attainment.

Maximum efficiency results when the necessary amount of fuel is completely

burned with a minimum excess of air, and the flue gases leave the boiler with the lowest temperature consistent with the rate of driving. Without adequate means of knowing when this condition obtains, it is impossible for even the most expert fireman to maintain maximum efficiency.

Combustion experts when conducting efficiency tests generally determine the percentage of CO_2, CO and O; but for everyday practice it is necessary only to know the percentage of CO_2 and the temperature of the flue gas to be able to tell whether the boiler is being operated economically or wastefully, and to what extent heat is going to waste up the chimney. Not less than 90 per cent. of the avoidable heat losses in the operation of steam boilers are due to excessive air supply, and since the percentage of CO_2 in the flue gas is a correct index of the excess of air it contains, an instrument that will continuously indicate and record this constituent is a most important if not an absolutely necessary factor in attaining and maintaining maximum boiler efficiency.

Temperature Records.

A continuous record of the temperature of the escaping flue gas, although less valuable for controlling the boiler operation, is nevertheless of great importance. The temperature when recorded simultaneously with the CO_2 will give most valuable information as to the condition and operation of a boiler. The temperature of the flue gases is but slightly affected by excess of air supplied to the furnace; hence—cannot be directly controlled by the fireman. It depends on the ratio of heating surface of the boiler to the grate area, on the condition of the heating surface, and on the rate of driving. The stack temperature is also markedly affected by air infiltration, while an excess of air supplied to the furnace affects the stack temperature but slightly. Thus, it is seen that while the stack temperature alone may give very misleading information, in conjunction with a determination of the CO_2, very valuable information is had about the condition of the boiler itself as well as the boiler setting.

Draft Measurement.

A draft gage applied to the furnace shows the resistance through the ashpit door, the grates, the ashbed and the fire. With a given effective draft, if the ashpit doors are partially closed, the furnace draft is increased, but the rate of combustion is decreased. The same effect is produced by the accumulation of ashes, the formation of clinker and the caking of the coal. The furnace draft is thus increased by at least four distinct causes, all of which tend to check the rate of combustion. On the other hand, if the fire is sliced, the furnace draft is decreased and combustion is increased, and still more is this the case if the fire is cleaned. It is clear then that the readings of a draft gage in the furnace cannot be relied upon as an index to the rate of driving, much less to economical operation.

General Conclusions.

From the foregoing it would appear, first, that the chimney draft is affected favorably by wasteful boiler operation, due to high stack temperature and unfavorably by wasteful operation, due to a low percentage of CO_2 in the flue gas; but that a knowledge of the chimney draft and temperature is of great value as a check on economic operation of a boiler plant. Second, that the effective draft upon which depends the rate of combustion is itself dependent on the variable conditions of the furnace; therefore, it cannot be relied on as a guide by which to regulate combustion. Third, that furnace draft due to the ever changing conditions, must necessarily vary if a definite rate of combustion is to be maintained, and is, therefore, useless as a guide, but of the greatest value as an index to the condition of the furnace, provided there is a true index to the rate of combustion. Fortunately, such an index can be made available.

From what has been said, it should appear evident that in order to attain and maintain high boiler efficiency, it is necessary to employ scientific means for the purpose of gaining the information necessary to economical operation.

IMPULSE TURBINE EFFICIENCIES.

The curve, Fig. 1, relates to an impulse turbine installation at Adamello, working under an effective head of 3,000 feet, each unit being designed for a maximum of 6,600 B.h.p., when running at a speed of 420 r.p.m. These turbines are all of the Escher Wyss Co. special design and patent, fitted with deflecting nozzle which eliminates the employment of any relief valve, while at the same time keeping the rise of pressure in the penstock remarkably low. As a matter of fact, when tests were made and the full load thrown off, the pressure at the end of the penstock only rose to a very few per cent. above normal.

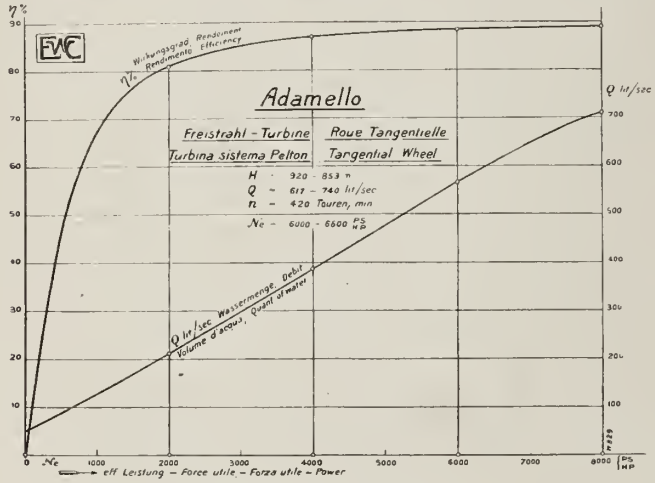


Fig. 1—Efficiency Curve.

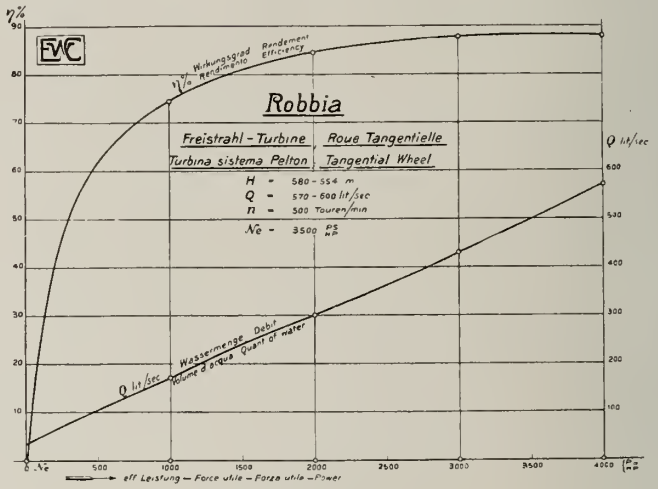


Fig. 2—Efficiency Curve.

The efficiency attained exceeded the guarantee requirement by about 8 per cent., and is remarkable because of the fact that it remains above 80 per cent. from over-load to one-quarter load. A general description of this plant was given in the May, 1911 issue of The Power House, details of the machinery being fully described.

Robbia.

The curve, Fig. 2, relates to the same type of turbine as above described, the effective head being 1,900 feet and each unit having a capacity of 3,500 B.h.p., when running at a speed of 500 r.p.m. The efficiency in this case shows also above 80 per cent. from full load to almost one-quarter load. Adamello and Robbia where the equipments are installed are situated on the Swiss and Italian border.

THE READERS' POINT OF VIEW

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

GAS PLANT BREAKDOWNS.

By J. A. S.

IN the best forms of mechanical construction there is a tendency at some time or other for the apparatus to break down and refuse to perform its duties until attention has been paid to the cause. In this respect, the internal combustion engine, whether driven by town gas, producer gas or oil, is no exception. It therefore devolves upon the engineer in charge of such equipments to keep a very careful watch for flaws which may from time to time be developing, in order to save, if possible, the plant from the larger troubles likely to arise, if the preliminary defects are

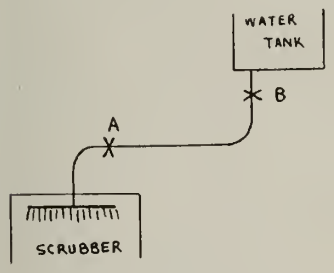


Fig. 1 —Gas Plant Breakdowns.

allowed to continue for too long a period.

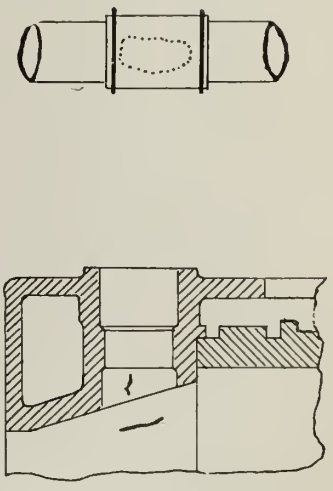
Valve Gear Troubles.

A large proportion of the difficulties arising in connection with gas engine practice, is due to troubles originating in the valve gear. Moreover, it is often found that the trouble in the first instance was of a very paltry nature, reaching importance only because of initial neglect. For example: In one installation no less than three exhaust valve heads snapped within the period of a month, and investigation was made as to the cause. On looking into the matter, it was seen that the clearance between the exhaust valve cam and roller was as much as 5-16 inch. There is hardly any need, of course, to point out that an excessive amount of shock was thereby given to the valve; besides, there was further trouble involved, due to the fact that the late opening and early closing of the exhaust, caused a considerable loss of power in the engine. Evidently, therefore, the operator should have been instructed to have seen that the valves were properly adjusted; this being one of those cases in which a little further attention on the part of the man in charge would have been valuable.

In numerous instances again, the troubles which develop in gas plants are due to a display of insufficient foresight in the original installation. Many times it would almost appear as if the designer had been looking for trouble. Only one instance of such defective lay-outs need be given here; being purposely selected on account of its simplicity. In this, a producer gas installation, the scrubber had its water pipe arranged so as to feed from an overhead tank, shown roughly in the sketch, Fig. 1. It will be seen that closely adjacent to the top of the scrubber was a valve by means of which the tank water was shut off from the scrubber when the gas plant was not in use. Unfortunately, however, the plant was situated in a cold climate, and this pipe leading from the water tank to the scrubber fractured along its horizontal length, due to frost. The fracture probably occurred at an original defect, because a piece of the pipe came right out solid. The mishap need not, however, have occurred, if the valve placed at A had been located at B instead, immediately below the water tank, and this could quite well have been done without interfering with the comfort of the attendant in opening or closing the supply, as it was not above the hand level of a man standing up. A temporary repair effected by refitting the piece of metal which had dropped out and fastening it with tarpaulin and tar bands, is shown in Fig. 2.

Repair Ingenuity on the Spot.

In the best regulated gas engine installations, trouble occasionally arises from wear and tear. When the plant is in an isolated location, away from manufacturing shops, many effective repairs are carried out by operators who are content to let their ingenuity remain hidden. An instance of this nature is shown in Fig. 3. Two cracks developed in the breech end of a gas engine, and at first sight it looked as if a very extensive repair would be necessary in order to get the engine again into proper working order. The whole matter was, however, simply and effectively dealt with by the engineer treating the cracks with a strong solution of sal-ammoniac. The compression space of the cylinder was filled with this liquid and left in there for about twelve hours. The result was that both cracks were satisfactorily rusted-up and further trouble avoided. This method is frequently adopted by engineers who know the wrinkle, and is worth remembering, inasmuch as it is cheaper than fitting liners.



Figs. 2 and 3 — Gas Plant Breakdowns.

It is hardly advisable at the present time to further extend the list of troubles and their cures. The cases mentioned, however, are illustrative of a large range of these, which can either be caught in time so as to avoid unnecessary expense, or else can be cured with an application of a little common sense allied with ingenuity; and in view of the widespread use nowadays of gas engine plants for the purpose of driving electrical machinery, etc., it is hoped that the foregoing notes will be of interest.

USE OF OIL IN STEAM LINES.

By W. W. Chisholm.

THE use of oil in steam lines and headers does not appear to be as general as it might be. I have found it of great benefit in stopping leaks, particularly in the plant of which I am in charge. We have a 12-inch header, 86 feet long, and a 3-inch header about 8 feet long. These carry steam to 2 large railway shop units, feed pumps, etc., and the conditions are such that large and small leaks must be avoided as far as possible, while at the same time, should they occur, a minimum of trouble and expense must be involved in their cure.

The remedy adopted and applied consists in placing a lubricator in the boiler room by means of which to feed oil into the steam lines. To begin with, about a quart of oil per day is used, reduced afterwards to an average of 3 pints per week. The oil works into the small leaks, caking them up, while lubricating at the same time valve stems and packing, and preventing erosion of piping, etc. Naturally, it tends to clog the traps, but the cleaning of these is an easier matter than repairing joints.

It will surprise those who have not tried the experiment to find how large a leak can be so stopped. I have seen a leak in a screwed joint of a line carrying a steam pressure of 150 lbs. per square inch, the noise of which could be heard distinctly 100 feet away, stopped by this oil method in 60 hours, and take up for keeps. Engineers having leak troubles on their headers and steam lines are advised to try this oil treatment, as I believe they will find its application not only a freedom from annoyance, but a great saver of labor.

DEFECTS IN BOILER CONSTRUCTION.

By T. Osborne.

MANY boiler experts are under the impression that the well-known and very generally used Lancashire boiler, even in its present highly perfected state, has defects, which further study could eliminate. One such is here described. The problem is that of the front heads. It is found that grooving or fracturing takes place in the roots of the flanges and if attempt is made to prevent leakage by applying larger rivets round the furnace mouths and screwed and riveted studs in gusset angles; an expensive repair is involved. Such necessity, however, should not arise, for in many cases no trace of either grooving or leakage is apparent. In these latter, it is generally found that the boilers have been well looked after; a feature which always pays.

While generally admitted that the flat front head is not the strongest form, yet it is also well known that other forms have also their weak points. The flat head is extremely suitable for the fixing of the several fittings and furnace appliances, besides, it would be a mechanically easy undertaking to strengthen it so as to carry a fixed dead load. The actual condition is,however, a live, active and somewhat uncertain load, liable to set up strains which may at once convert strength into weakness; therefore, the problem confronting boiler designers is that of providing a head sufficiently strong to carry the load due to pressure and at the same time sufficiently flexible to accommodate the continually varying movements due to expansion and contraction. Some progress it is believed has been made; but critical experts are not satisfied that the best possible has yet been achieved. They assert that the staying of a flat head by means of rigid gussets is not a very scientific arrangement, although meantime, perhaps, the most practical.

Temperature of Furnace Crown.

The varying temperature of the furnace crowns as compared with the temperature of their undersides, and those of the shell crown—the former having a much greater range than the latter, especially when steam has to be raised from cold water, is the cause of the movement from which the trouble arises. It is known that when a boiler is in operation, the temperature of the furnace crown may vary through a range of several hundred degrees, while the shell crown temperature may remain practically constant at the pressure temperature. The presence of deposits, grease restricted or narrow water spaces may still further intensify this varying temperature, as does also the rate of fuel consumption and power of draught, natural or artificial. Such increases of temperature, must necessarily cause increase of movement. This, being absolutely uncontrollable must be accommodater irrespective of the load to be carried due to the steam pressure, which would not come on until the front end plate has been distorted from the flat to some other shape, and some portions of the gussets be carrying a similar excess load.

In order to increase the flexibility of the front head plate, very important alterations have been recommended and made, with undoubtedly good results, but practically nothing has been done to move the evil influence of the furnace crown on the rigid base of the furnace to the front attachment. It is common knowledge, that keeping the fires well clear of the furnace doors makes it possible to increase the breathing space of the furnace crown, but how often is this simple precaution neglected, either through ignorance or want of proper supervision. It is the general opinion that this is of far greater importance than the breathing space on a front head plate, and were it possible to keep the fires at least eighteen inches back from the doors, or better still, not nearer the front than the first flange seam, there would be little trouble of the sort described.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

STEAM TURBINE BUILDERS.

ACCORDING to a contemporary there are forty firms building turbines in England, of which twenty build marine turbines only. Of the marine turbines built, all but two are reaction turbines, but of the land turbines about fourteen are impulse machines of various designs. Among these it is interesting to note at least two firms specialising in small turbines, the market for which does not seem to be fully appreciated. On the continent of Europe, there also appears to be forty firms known to build turbines. Of these, the majority are for land, or land and marine purposes. About eight are reaction turbines and the remainder impulse.

The more extensive adoption of the impulse turbine on the European continent is partly the result of patent difficulties and also because the possible variations in design are much greater with that type than with the reaction type. Several firms embody an impulse high-pressure section in conjunction with a reaction main turbine. It is believed that the number of steam turbine builders is not so very large in the United States, and of these many of the most important build to modified foreign designs. A notable exception is the General Electric Co. of Schenectady.

BOILER ROOM ECONOMIES.

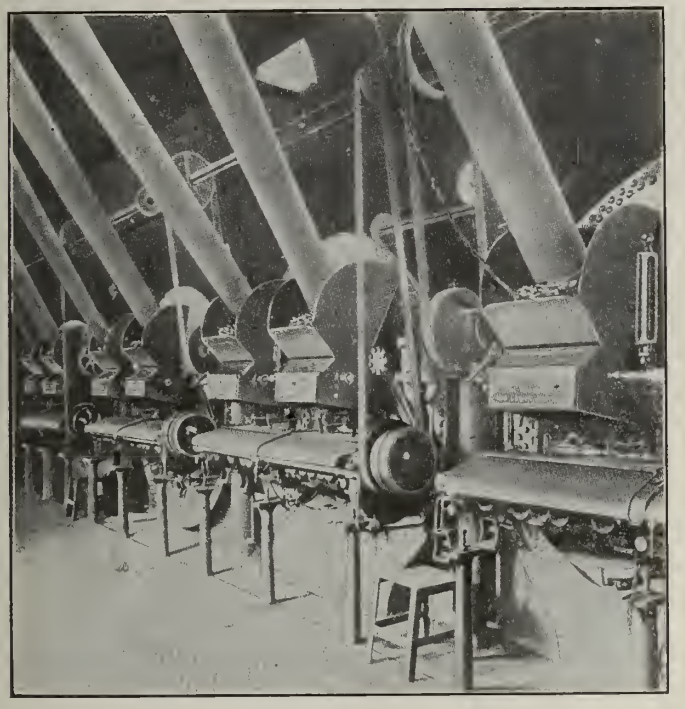
By Bellfield.

AMONG the several types and many variations of boilers, that have been designed by close students of boiler-house practice, are two ar three that persist and may be said to obey the law of the survival of the fittest. The elimination of the unfit among boilers, as among many other objects, is a slow process. This accounts for the fact that there are boilers still in use to-day that a few years hence will more directly serve the purpose of engineering vagaries than the makers and users of steam. Among the types that persist are the Lancashire, the Cornish, the water-tube and the smoke-pipe set in brickwork. There are boilers that by a kind of compromise combine in their personality several of the features of both shell and water-tube, but it is not with any of these variations, useful as they may be, that we are now concerned.

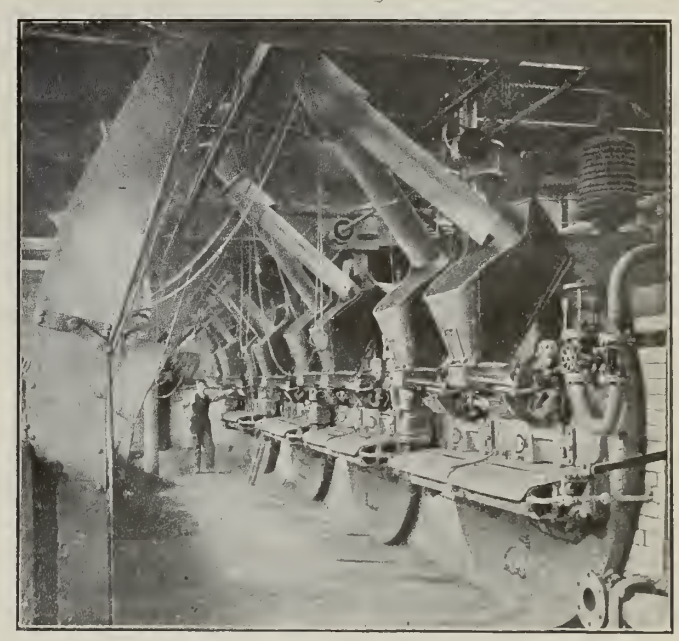
Mechanical Stokers.

The usefulness of the most useful boilers has during the last twenty years been greatly augmented by the substitution, throughout wide industrial areas of machine-stoking for that of hand-firing. By this system of steam-raising, the capacity of the boiler has been greatly increased, fuel costs reduced, smoke abolished, and a condition of comfort and cleanliness induced in the boiler-house that was altogether foreign when the fireman with his shovel was responsible for the steam output. It was formerly necessary to use costly coals which were shovelled in to the fire through the fire-door, with its frequent opening to admit of the operation being performed. The burning of dear coal did not ensure a high boiler duty because sudden draughts of cold air tended to reduce the boiler temperature, and to bring down the steam supply.

Since machinery has taken the place of manual labor it is no longer necessary to use high quality coals of high cost, as clear, strong, fires can be kept with poor low-grade fuels, at a proportionately lower price, while the necessity for flinging open the furnace doors every time the fire requires mending has been altogether negatived; the stoking machine being so designed as to feed the fuel on to such portions of the fire as require it, with the fire doors closed all the time. There is no fire-mender, in the best meaning of that term, equal to a well-designed, carefully-constructed machine stoker and self-cleaning compressed air furnace, and the cleanliness of the fire-bars, which is ensured by the pressure of the air through the perforations is a guarantee against costly and troublesome clinkering.



"Bennis" Coking Stokers with Coal Feed by Distributing Shoots.



"Bennis" Machine Stokers and Self-Cleaning Compressed Air Furnaces. Elevator Coal Feed.

Some Mechanical Stoker Types.

It seems desirable at this point to name and briefly describe some prominent types of machines designed, constructed and installed, an intimacy which it is desirable that both user and operator should cultivate. Those referred to in this article are as follows:

(1) Stokers of the sprinkler type.
(2) Stokers of the coker type.
(3) Stokers of the chain grate type.

Sprinkling Stoker and Self-Cleaning Compressed Air Furnace.

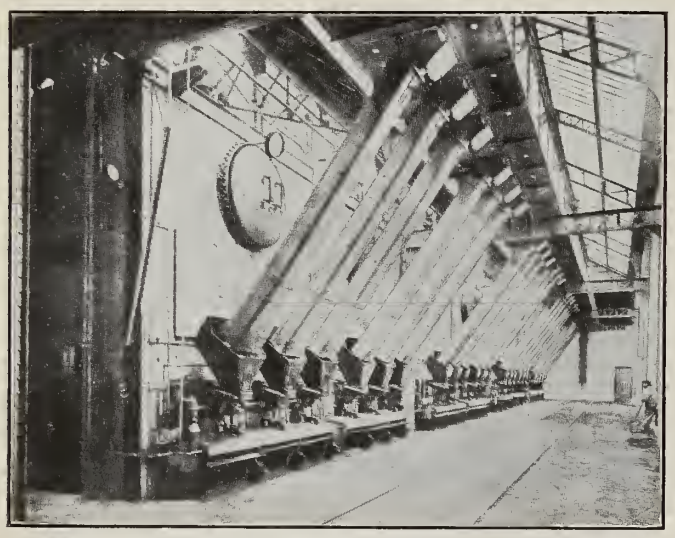
This machine feeds the fuel on to such parts of the fire as require it, and in small quantities at a time, so that its bright incandescent glow is not dimmed by the fresh fuel; the result being a clear, strong fire, without smoke constantly sustained and a plentiful supply of steam. The fire bars are so made that they cannot be stopped up by clinker or ash. This is an advantage that those who are practically acquainted with the combustion of low-class or waste fuel and its attendant troubles will duly appreciate. Clinker and ash are automatically removed from the fire where this type stoker is in operation, and on account of the grate bars acting independently of each other, individual bars can be removed or replaced without interference with the rest of the fire surface.

Combustion is effected, when the ordinary coking stoker is used, by feeding the fuel on to the front of the furnace, whence it travels slowly down by means of moving bars, becoming incandescent as it passes toward the back of the grate. The difficulty of keeping steam with this type was due to the inability of the fire to light back at more than a certain speed, owing to the lowering of the temperature below combustion point when too much fuel was fed on to the fire. Another practical difficulty was that of a sufficient, yet economic, air supply to the cohesive mass of coked fuel. It was, of course, quite an easy matter to increase the draught, but it was not possible to increase the rate of lighting back in the same proportion, the effect being the prevention of high efficiency. A

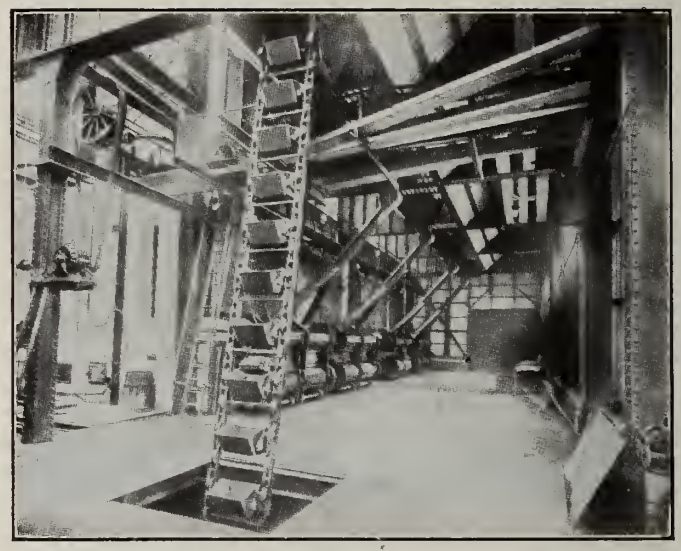
high temperature coking stoker and self-cleaning compressed air furnace from which these and other disadvantages are altogether eliminated, has been designed recently, and the results obtained from its operation show a great advance over those got from the ordinary type.

Chain Grate Stokers.

The principle of feeding fuel on to a grate moving at a regulated pace as an endless chain and carrying the fuel with it, is a matter of ancient history. Innumerable experiments had failed to render it an economic success. The faulty design of the links, allowing as it did an excess of air, and the weakness that made the clumsy contrivance of dumping bars a necessity, earned for the chain grate a reputation for extravagance and inefficiency. The halving of the link at the junction of the ends, excluding as it does the excess of air, and the modification of the design, whereby the abolition of the troublesome dumping bars has been rendered possible, is an improvement of so radical a nature that it may almost be said to amount to a new principle.



"Bennis" Stokers and Self-Cleaning Compressed Air Furnaces on a Battery of Water Tube Boilers.



"Bennis" New Link Chain Grates. Coal Elevated by Gravity Bucket Conveyor.

Elevating and Conveying Machinery.

We now consider another point of economy connected with machine-firing, viz., that of the use of elevating and conveying plant for transporting the coal from the canal barge or railway truck to the stoker hoppers. One of the chief difficulties in the large modern boiler-houses is that of getting coal to the boilers. It has been suggested that the ideal condition for boiler-house practice is that from coming into the yard as coal to going out therefrom as ash and clinker, the manual labor expended on fuel shall be a minimum. This condition is now rendered possible by the use of mechanical means, and it is now generally conceded that a coal and ash handling plant, including conveyors and elevators for collecting, transporting and distributing, is, if adequately designed, carefully constructed and judiciously installed, a conspicuous economic success. Wherever, on the other hand, conveying systems have been installed at a needlessly large outlay and without reference to the special requirements of individual cases, the practical results have been extremely disappointing. Complexity and costliness are not the sine qua non for efficiency and scope of application. Where boiler-houses are small, or, by reason of their arrangement, an elevating and conveying plant cannot conveniently be put down, the use of small elevators is advisable, either one elevator to each boiler or one to every two boilers.

Requirements and Advantages of Mechanical Stokers.

1.—The economic mechanical transport of coal from barge or truck to stokers hoppers.

2.—A distinct design of stoker for any type of boiler whereby the economic combustion of any class of coal is ensured.

3.—Cheap steam without smoke, smuts or grits, and the consequent abolition of smoke fines.

4.—High boiler duty from low-grade fuels.

5.—Reduced coal bills and increased steam supply.

6.—Ability to keep steam with varying loads and to meet with facility the overload.

7.—Rapidity in steam raising.

8.—Minimum labor costs.

9.—A widening of the area of coal supply and increased independence of individual markets.

10.—Clear strong fires with slack and pit rubbish.

11.—A reduction of the fuel bill with equal boiler duty with the same fuel bill, without detriment to the boiler.

12.—Specific guarantees of economy and efficiency, by which each installation becomes an investment and not a mere speculation.

The writer is indebted to Mr. George H. Tod, manufacturers' agent, Manning Chambers, Toronto, for the illustrations accompanying this article.

NEW METHOD OF MEASURING STEAM CONSUMPTION.

THE steam consumption of a turbo generator has been reduced to as low as 12 lbs. per kw. hour. This high economy is secured by careful operation and by refinements in the efficiency of auxiliary apparatus. If, however, the operating force has no guide in maintaining high efficiency, a fall in pressure, superheat or vacuum, a badly adjusted load, or wear of turbine blades, may cause loss of economy which is far more serious than generally realized. For instance, in a recent case, a turbine had been operating for some unknown reason at 125 per cent. of its normal steam consumption. This condition was not discovered for some time, in fact until the boiler load had become so excessive that it could no longer pass unnoticed. Finally, after several months it was concluded that the trouble lay with the turbine and steps were taken towards making proper repairs. In the meantime, the excessive steam consumption of the turbine had caused a loss of about five tons of coal per 1,000 kw. per day, or in three months, with coal at $3 per ton, a loss of $1,350 per 1,000 kw. load.

The Indicating Hot Well.

The steam consumed by a turbine or engine can be determined with absolute

accuracy by weighing the "steam water" or condensate from a surface condenser. Very few plants have employed this method of measurement, due to the fact that ordinary weighing or measuring devices are costly and clumsy, adding not only to the expense but complicating piping, and withal, perhaps none too accurate. A simple, accurate and direct solution of the problem is presented in the indicating hot-well, Fig. 1, which is similar in size and appearance to the ordinary hot well and is attached directly to the bottom of the condenser, forming a part of the shell. The opening in the bottom of the condenser is built so that the condensate drains into the left-hand chamber of the hot-well, and communication from this chamber to the hot-well pump suction is secured through an orifice in the dividing wall. The velocity of discharge through an orifice of given diameter, varies directly as the square root of the head, and the quantity of water discharged is equal to the product of this velocity, the area of the orifice and the co-efficient of contraction. With a properly designed orifice this co-efficient remains almost exactly constant for widely different values of the head upon the orifice, and, therefore, the quantity of discharge is obtained with a high degree of accuracy by a carefully calibrated indicating gauge glass, reading the head.

Fig. 1—Surface Condenser, showing indicating hot well attached directly to condenser shell, replacing the ordinary hot well.

Indicating Gauge Glass.

As may be seen from the illustrations the orifice is formed in a brass plate inserted in the partition wall. It is polished and finished to insure accuracy of flow. Especially manufactured fittings are used to attach the indicating gauge to the shell of the hot-well. Ball check valves are provided in each fitting so that should the gauge glass break, the inflow of air will be prevented and the gauge glass can be replaced at leisure. A gauge glass is also provided to show the height of the water in the hot-well suction compartment, where the water must not be allowed to submerge the orifice. The scale attached to the indicating gauge reads directly in pounds of steam per hour, as shown in the drawing. Each orifice is made independently, carefully calibrated, and a special scale, etched upon steel, furnished for it. Over the whole range of readings, the accuracy is within 2 per cent., and for readings from 75 per cent. to 125 per cent. load, the accuracy is within 1 per cent.

The indicating hot-well is a practical and simple solution of the problem of measuring steam consumption. The indicating gauge reads pounds of steam per hour; the station watt meter gives load in kw., and the rate of steam consumption in pounds per kw., hour is obtained by simple division. This figure entered regularly upon the engineer's log sheet, and charted from day to day, is of the greatest importance in maintaining high plant economy.

The manufacturers of this equipment are the Wheeler Condenser and Engineering Co., Cartaret, N. J.

THE RAILWAY EQUIPMENT CO., OF TORONTO, LTD.

A RECENT addition to the industrial organization of the Queen City is that of the Railway Equipment Co., of Toronto, Ltd. While the name indicates in a general way the nature of the firm's business, it may be here stated on the authority of information received by our representative, that the work undertaken will partake more specifically of the repair, rebuilding, exchange and supply of electric railway equipment, consisting of trolley cars complete, car bodies, trucks, motor apparatus, individual motors, armatures, armature cores, field coils, etc. A well equipped repair shop, located at 1240-1250 Dundas street, Toronto, forms a feature of the company's plant, and realizing the importance of the armature department, the management have secured the services of a superintendent of large experience to take charge of same.

The officers of the company are: President, William Harper, Toronto; secretary, Geo. H. Crow, Reading, Pa.; and treasurer, C. L. Allan, New York City.

LUNKENHEIMER CAST STEEL VALVES.

SUPERHEAT and high steam pressures have created a demand for valves of greater strength and durability than those made of cast iron. Always anticipating the requirements of the trade, the Lunkenheimer Company has designed a complete line of globe, angle, cross, gate, check, non-return boiler stop, etc., made of cast steel, all of which will be found in actual use and giving perfect satisfaction in a large number of high-pressure power plants. With the exception of the largest sizes, the Lunkenheimer cast steel valves are made of crucible steel and not open hearth or converter steel. Crucible steel is made and melted in closed crucibles, out of

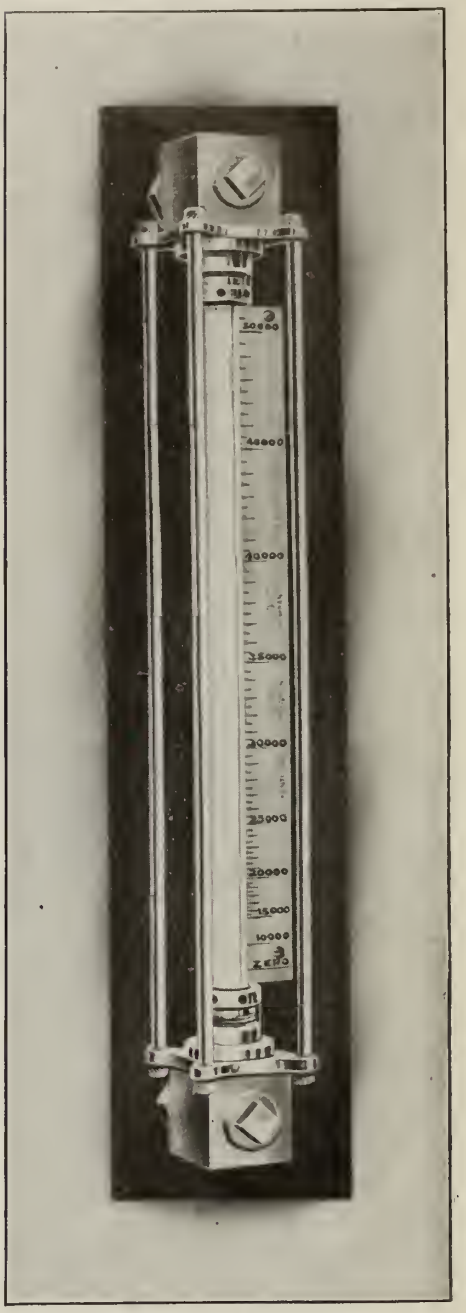


Fig. 2—Gauge glass and scale of Wheeler indicating hot well.

all exposure to furnace gases, and solid castings free from blow-holes are insured. This is not true of the open hearth and converter steels, the first of which is heated by blowing hot gases over the molten metal, and the second by blowing them sometimes through the metal. Aside from forming blow-holes, these gases form oxides, which dissolve in the steel and thereby reduce its ductility and cause a low elastic limit.

All of Lunkenheimer cast steel valves are annealed, which relieves internal stresses and gives a fine crystalline structure, which is very essential to strong steel.

The Lunkenheimer Company claim that their valves are the only ones which are made to meet the standard specifications, and that they are the only steel valves containing less than .05 per cent. of either phosporus or sulphur. The tensile strength of Lunkenheimer cast steel is about 80,000 pounds per square inch, with a safe elastic limit and excellent elongation. For various pressures and degrees of superheat and to meet the requirements of engineers who differ as to the material used, Lunkenheimer cast steel valves are made in two combinations of materials as regards the trimmings. For lower pressures and degrees of superheat, the company manufactures a large and complete line of cast iron and "puddled" semi-steel valves. Descriptive matter pertaining to these cast steel valves may be had by writing the Lunkenheimer Co., Cincinnati, Ohio.

Questions and Answers

By R. A. G.

Q.—If the fire-door and dampers are not kept shut while the fire is burning out, what is likely to happen? A.—The boiler will soon get leaky.

Q.—How should a boiler be emptied? A.—It should be allowed to cool, and the water should then be run out or pumped out.

Q.—What may be done to cool the boiler while the fire is burning out? A.—Let the steam escape gradually from the safety valves, then take the man-hole door off.

Q.—Why should cold water not be put into a boiler to cool it? A.—Because it causes it to leak and wear out quickly.

Q.—If the water gets too low in a boiler, what should be done? A.—Draw the fire, ease the safety valves, and put no water into the boiler until the plates have cooled.

Q.—If the water is a little low, but not so low as to leave the plates uncovered, what should be done? A.—Throw wet ashes on the fire, shut the damper, and pump the boiler up.

Q.—When the blow-off cock is open, where should the boiler attendant be? A.—Standing by the cock, and watching the glass gauge, so that he may shut the cock as soon as the water is low enough.

Q.—If there is no damper fitted, what should be done in the case of the water being rather low? A.—Throw wet ashes on the fire, open the fire-door, and pump the boiler up.

Q.—If a boiler primes very much, what should be done? A.—Check the fire, shut the damper, open the fire-door, and put enough water in the boiler by pumping it in.

Q.—How should the fire be fed? A.—Quickly and regularly, and the fire-bars should be evenly and well covered.

Q.—Where should the coal be thrown? A.—On the part of the bars where required.

Q.—Why should the fire-bars not be allowed to get bare? A.—Because cold air will rush into the furnace.

Q.—Why should the pressure be raised, at least once a day, until steam blows off at the safety-valves? A.—To insure that the valves are in working order, and to ascertain whether the pressure indicated by the pressure-gauge is the same as the pressure to which the valves are loaded.

Power House Equipment

If you want to Buy, Sell or Exchange

CONSULT US ON

POWER HOUSE APPARATUS

Air Compressors
Alternating Current Generators, belted
Alternating Current Motors
Arc Dynamos
Arc Lamps
Boilers
Booster Sets
Condensers
Direct-Connected Units both alternating and direct current
Direct Current Generators, belted
Direct Current Motors
Electrical Instruments
Engines
Feed Water Heaters
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Turbines, both steam and water.

WE ARE THE MEN BETWEEN.

Railway Equipment Company of Toronto, Limited

1240-1250 Dundas Street, TORONTO, ONT.

Phone Junction 1247

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BUY THE AMERICAN LINE

High Grade Steam Specialties

GAUGES VALVES INDICATORS

for every variety of pressure.

THE AMERICAN H^2O GREASE EXTRACTING FEED WATER FILTER.

THE AMERICAN UNIVERSAL

Combined Speed, Pressure and Emergency Pump Governor

and kindred appliances of every sort for measuring and controlling power.

Made only by the

American Steam Gauge and Valve Mfg. Co.

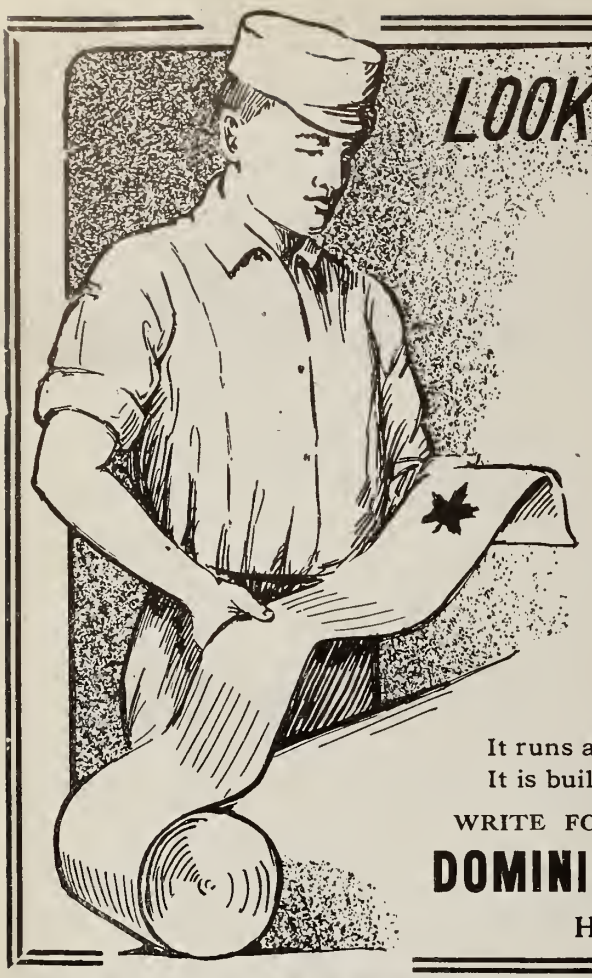
CAMDEN STREET, BOSTON, MASS.

DISTRIBUTORS FOR CANADA AND THE PROVINCES;

The Canadian Fairbanks-Morse Co., Limited

Montreal St. John Ottawa Toronto Winnipeg Calgary Saskatoon Vancouver Victoria

The Extensive Organization and well known reputation of this Company, not only substantiates the high quality of American Products but also assures customers throughout Canada and the Provinces the promptest and most able attention.



LOOKING FOR THE "MAPLE LEAF"

is increasingly a habit with those who buy much Belting.

The reason is not hard to find, for there is no part of your Belting system, from the main drive to the smallest light Belt for power transmission, where you will not get the best kinds of service from

"MAPLE LEAF" BRAND Stitched Cotton Duck Belting

It is the most economical Belting because it is durable under every condition; even where other Belting will deteriorate rapidly. It is water proof.

It runs absolutely true on the Pulleys.
It is built of plies of selected duck.

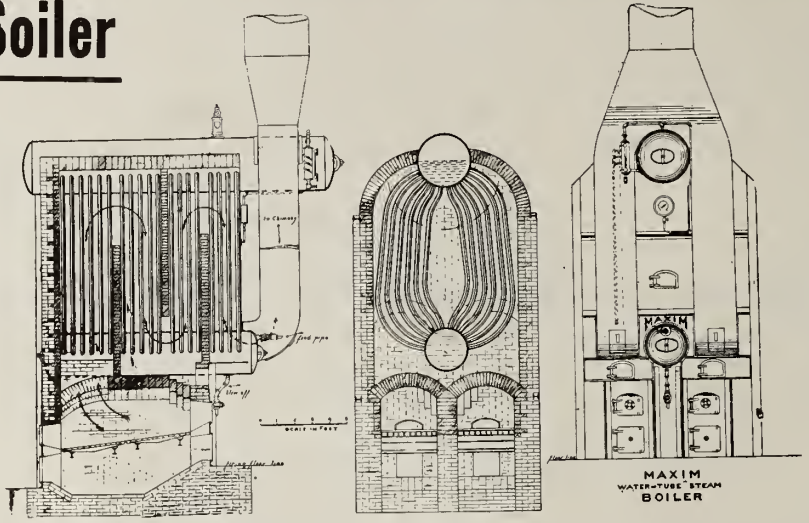
WRITE FOR INFORMATION AND PRICES

DOMINION BELTING CO., Ltd.

HAMILTON, CANADA

The Maxim Boiler

Did you ever operate a steam boiler—hard — for all it was worth? If for any considerable length of time, the tube ends leaked —unless with bent tubes. This Maxim Boiler will run at 100 per cent. overload, and the tubes will not leak. They never work loose. You know how straight tubes get leaky and have to be expanded from time to time to keep them tight until the ends are cut through with the expander and the tubes must be replaced.



Mr. Allan Stirling invented the Stirling Boiler, and after ten years' experience with the Stirling put the Maxim Boiler on the market—the most economical boiler made.

The Maxim Boiler could not be more simple. It consists of two drums and connecting tubes. You can see for yourself just what the boiler is.

An inspection of this boiler is not an all day job. Two man holes give complete access to the interior, and half a dozen brick work doors allow entrance at all parts of the exterior. You open the boiler and thoroughly inspect it without anything interfering with you. The firemen call it an easy job and the engineers find it a satisfactory job. It is done quickly and thoroughly without trouble.

The Keystone Watch Case Company, of Philadelphia, have tested their Maxim Boilers thoroughly, getting over twelve pounds of water per pound of combustible with flue gases below 400 degrees Fahr., and steam at 135 pounds pressure.

An ordinary boiler tube in being heated from cold water temperature to the temperature of the steam will increase in length about three-eighths of an inch. If the tube is straight and held rigidly at both ends, this expansion will either bend the tube or loosen the tube ends. If the tube is already bent the bend will increase, just as an already bent stick will bend more if leaned on.

Maxim Tubes never leak at the ends. They bend to take up differences of expansion and contraction. No strain is thrown on the expanded joints. Maxim tubes **never** work loose.

Ogilvy Engineering Company, Bank of Ottawa Building, **Montreal**

There is but ONE BEST in Anything

In Boiler Cleaners it is the **LIBERTY.**—Best in design and construction, best in economy of operation, and best in thorough work. It removes all the scale from the tubes and restores their original efficiency. It does the work in the shortest time and at the least cost for repairs.

When placing your next order for cleaners do not forget to specify the **LIBERTY,** and you will be sure of getting the **BEST.** We make Cleaners for every type of boiler, bent or straight tubes and to be operated by air, steam or water as required.

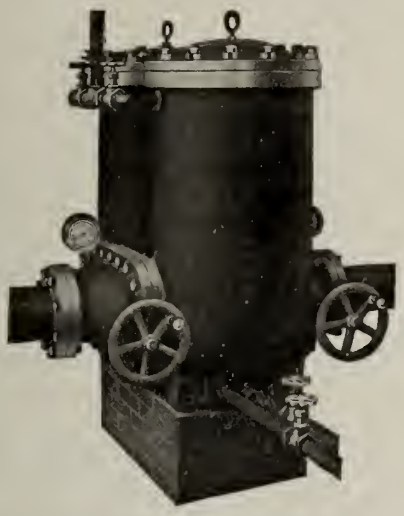
WRITE FOR CATALOG. DO IT NOW.

Liberty Manufacturing Company

6904 Susquehanna Street, **Pittsburgh, Penn.**

CANADIAN REPRESENTATIVES:

Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.



THE TWIN FILTER WAY

Is The

BEST WAY

To Take

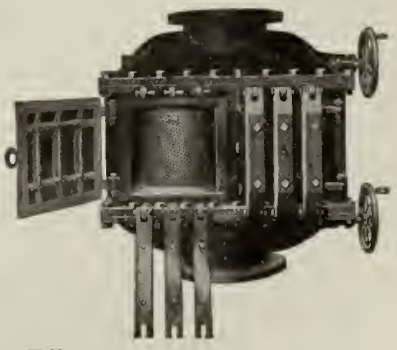
The Oil and Grease out Of Your Boiler Feed Water.

The **TWIN** is always on the job and does not by-pass a lot of dirt to the boiler when cleaning, as is the case with other filters. The **TWIN continous filtration** is essential if you want to keep that oil where it can't do any damage.

We also make **Twin Strainers** to keep the dirt out of the **Condenser** and **Water Supply Lines.**

Other High-Grade Power Accessories Include

Oil Purifiers for reclaiming Waste Oil, Exhaust Heads, Blow-Off Valves, Feed Water Regulators, all well de signed—well made—they do their work well.



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DIXON'S GRAPHITE LUBRICANTS

Dixon's Flake Graphite No. 1.
This is the standard size of Dixon's Ticonderoga Flake Graphite, and is recommended for general lubricating requirements.

Dixon's Flake Graphite No. 2
A more finely ground graphite than No. 1, though of the same stock. This is adapted to close-fitting bearings and delicate mechanism.

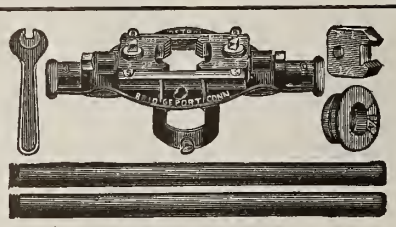
Dixon's Special Graphite No. 635
This is a selected grade of Dixon's Ticonderoga Flake Graphite ground even finer than the No. 2 Flake. It is widely used in stationary gas engines. This grade of graphite is also used on type-setting machinery.

Dixon's Waterproof Graphite Grease
A strongly adhesive grease of heavy body; cannot be washed off by fresh, salt, alkaline, or acid water. Especially adapted for wire rope, gears, slides, chains, elevatorways, mining and quarrying machinery, and generally on machinery exposed to water or the weather.

"Graphite As A Lubricant," and Sample 222C free.

JOSEPH DIXON CRUCIBLE CO.
Jersey City, N.J.

U.S. AND BARKEEPERS FRIEND
METAL POLISH
USED AND ENDORSED BY THE LEADING DEALERS
SOLD ALL OVER THE WORLD



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PIPE MACHINES
PIPE CUTTERS
HINGED PIPE VISES
RATCHET ATTACHMENTS

Manufactured by
THE ARMSTRONG MFG. CO.
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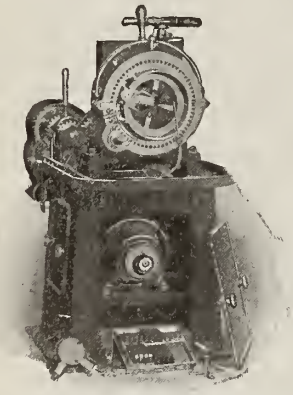
Catalog mailed on request



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The Forbes Motor Driven Pipe Cutting and Threading Machine.

Saves in time. It is compact and can be moved from place to place. No carting pipe to the machine.

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Saves in power. Motor is protected, and when not in use, power can be shut off. Various speeds obtained by lever control. Self contained, takes up no more space than a bench machine. It is the most efficient and economical machine of its kind.

Write to-day for Bulletins.

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CLASSIFIED ADVERTISING

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BELTING FOR SALE—800,000 FEET OF best quality leather, rubber, hair and canvas belting, bought from bankrupt manufacturers at 25% to 75% less than the regular value. Also a large quantity of slightly used belting, piping, chains, rails, pulleys, hangers, cotton waste, etc., at very low prices. Send for catalogue. Imperial Belting and Supply Co., 5 Queen Street, Montreal.

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LAKE ERIE BOILER COMPOUND CO. REquire a few first-class representatives to sell their well-known compound. Liberal commission paid to live men, and exclusive territory. Write at once, giving references, 11 Colborne St., Toronto. (tf)

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MODERN FIREPROOF CONSTRUCTION—Our system of reinforced concrete work—as successfully used in many of Canada's largest buildings—gives better results at lower cost. "A strong statement," you will say. Write us and let us prove our claims. That's fair. Leach Concrete Co., Limited, 100 King St. West, Toronto (tf)

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WANTED—EVERY POWER HOUSE IN Canada to remember that C. E. Shedrick, Craig Street West, Montreal, is still repairing measuring instruments, both switchboard and portable. Twenty-five years' experience in repairing all kinds and makes on the market. Intregating meters repaired, tested and sealed, and returned on quick time.

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Second-hand at half prices. New books at 25 per cent. discount. Books on Electricity, Machinery, Educational, Literary, Scientific and, all other Subjects, and for all Examinations supplied. State wants. Catalogue No. 545 Free. Books sent on approval. Books bought. Best prices given. W. & G. FOYLE, 135 Charing Cross Road, London, W.C., England.

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MECHANICAL MATERIAL CONVEYORS, INDUSTRIAL RAILWAYS.
Including Rails, Switches, Frogs, Cars, etc.,
—FOR—
MILLS, FACTORIES, MINES, GRAIN ELEVATORS

We carry in Stock a complete line of Transmission Equipment as below.

Iron Pulleys,
Solid and Split
Sprockets,
Bearings,
Gears—Spur, Bevel, Mitre,
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Couplings,
Post Hangers,
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Boots,
Boot Pans,
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Equipment and Supplies for 50 Grain Elevators carried in stock at all times.
SEND US YOUR SPECIFICATIONS.

THE MANITOBA BRIDGE AND IRON WORKS, LIMITED
WINNIPEG, MAN.

The "OTIS"

Water Purifying System

SAVES FUEL

and Boilers

A Few Facts for Steam Users to Consider

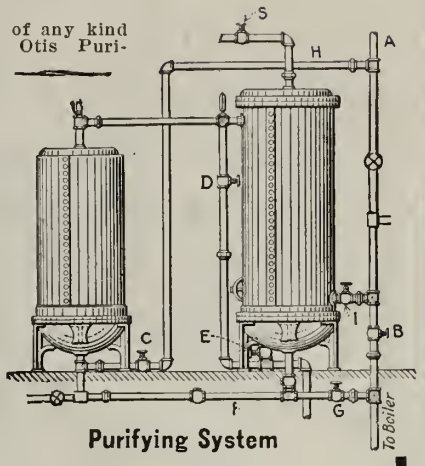
Why have trouble with your steam boilers on account of scale when no scale can form if pure water is used to make steam?

Why use boiler compound of any kind when we guarantee the Otis Purifying System will positively keep all scale-making material out of your boiler without the use of them?

Why feed warm water into your boilers when you can have feed water from 250 to 300 degrees Fahr. go into your boilers as pure as distilled water if an Otis Purifying System is installed?

Why pay good money for bad boiler compound when nine-tenths of them are no good, but very injurious to boilers?

Why not have clean boilers, when the saving in fuel, boilers and cost of cleaning will more than pay for an Otis Purifying System?



Purifying System

The Stewart Heater Co.

189 Norfolk Avenue, Buffalo, N.Y., U.S.A.

A STEEL GASKET

For Water Tube Boilers

The (Double R.-R.) Gasket

Made In Canada

We are the Sole Manufacturers in Canada of the Steel Asbestos Gaskets.

Mr. Engineer!

No more plates to clean, there is nothing in a steel gasket to melt or burn, and stick to the plates, just a steel shell filled with an asbestos cord. Cheaper and better than any other Gasket on the market.

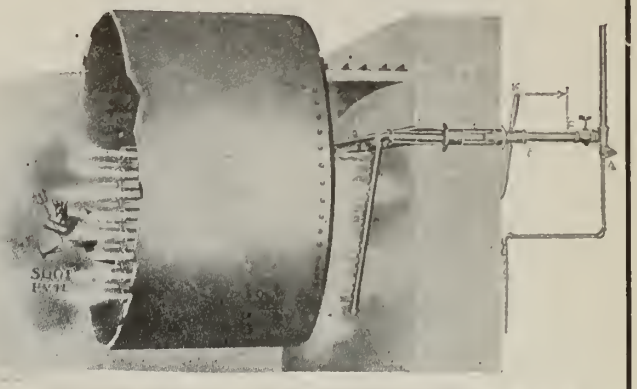
Write for free sample, naming the make of boiler.

CANADIAN GASKET CO.

BRIDGEBURG, ONTARIO

Corrugated Copper Gaskets of all kinds.

MORE STEAM



The Vulcan Cleaning a Return Tubular Boiler

LESS COAL

KEEP THE SOOT OUT OF THE BOILERS WITH THE

VULCAN SOOT CLEANER

You'll get more steam and you'll save 5 to 10% on your coal bill.

The difference between a clean heating surface in your boiler and a dirty one, is often the difference between dividend and deficit. It is the daily operatiug cost of a boiler that couuts. If the boiler tubes are coated with soot you face a drop in capacity and a **big loss in efficiency.**

The profit lost through a dirty boiler would pay for a Vulcan Soot Cleaner many times over. The Vulcan will produce a saving for you the same as it does for others. It is the **modern** way of handling the soot problem.

Soot defies removal by hand blowing. The Vulcan scours the tubes as clean as gun barrels—removes all soot in a few minutes—no shut-downs—no time waste—no dirt—no trouble—no air leakage—nothing but complete satisfaction and results.

We send the cleaner on 30 days' free trial—return it if you don't like it. We won't get "sore" nor try to force the cleaner on you. **IT'S UP TO YOU.**

Return the coupon and get our trial proposition and a free copy of "Economical Steam Productiou," a complete and pointed discussion on soot and how to get rid of it.

Cleaning Water Tube Boilers is also OUR SPECIALTY

Vulcan Tube Cleaning Systems

LIMITED

42 Craig St. West, MONTREAL.

SIGN, TEAR OUT AND MAIL

Power House, June 12. *Date*.....

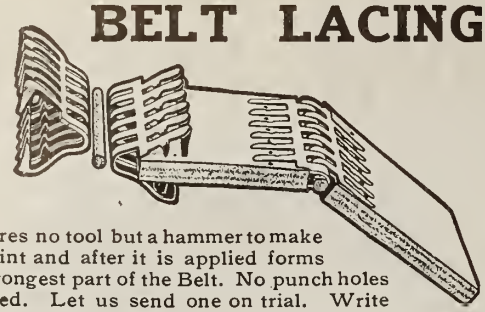
Vulcan Tube Cleaning Systems, Limited,
42 Craig St. West, Montreal.

Please send me without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.

(It is important that following information be given in full.)

Water Tube Boilers. Number.....Type.....Pressure.....
Horsepower.....No. Tubes High (except on Stirling boiler).....
Any Superheaters.....Width of alley space at side.....
Tubular Boilers. Number.....Horizontal or vertical.....
Name.....
Address.....

BELT LACING



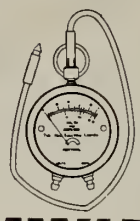
Requires no tool but a hammer to make the joint and after it is applied forms the strongest part of the Belt. No punch holes required. Let us send one on trial. Write for particulars

The Cresent Oil Company, Hamilton and Toronto, Ont.

Stocks carried by—Sadler &, Haworth, Moutreal; Austen Bros., Halifax; P. A. Gouin, Three Rivers, P.Q.; J. S. Mitchell & Co., Sherbrooke, P.Q.; Great West Engine Packing Co., Winnipeg; F. H. Andrews & Son, Quebec, P.Q.; E. N. Jones, St. John, N.B.

MAIL COUPON TODAY

Test Batteries, Ignition Coils, etc. with a Hill Pocket Volt-ammeter.



Sent post-paid $1.75. Money refunded if not satisfied.

The Hill Elec. Switch & Mfg. Co., Ltd.
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Name .....
Street .....
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"Standard" Service

The Bare and Weatherproof Wire and Cable Departments of our factory are now in full operation, ready to meet your every requirement promptly.

"STANDARD" Products have, for over 30 years, been made and sold upon a **quality basis,** which means greater *durability*, greater *safety*, greater *economy*.

"STANDARD" Bare and Weatherproof Wires and Cables are drawn from the best commercially pure copper wire-bars. The weatherproof insulation is mechanically perfect and will stand great extremes of heat and cold.

"STANDARD" Service also consists in quoting prices, shipping promptly and in supplying information generally about our products. We will promptly give assistance in solving your installation problems.

Send us your inquiries! *A post card will do!*

Standard Underground Cable Co., of Canada, Ltd.

Department B. Hamilton, Ont.

Manufacturers of Electric Wires and Cables of all kinds, all sizes, for all purposes, Junction Boxes, Terminals, Insulating Compounds, etc.

Pemco Tungsten Fixtures

are Especially Designed for

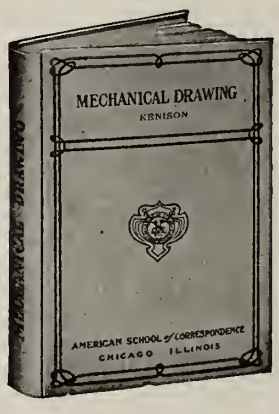
INDUSTRIAL and STREET LIGHTING

They are all
SIMPLE, DURABLE and EFFICIENT.

Write for particulars.

A. H. WINTER JOYNER, LTD.
76 Bay Street Toronto, Ont.

"Consult a Specialist"



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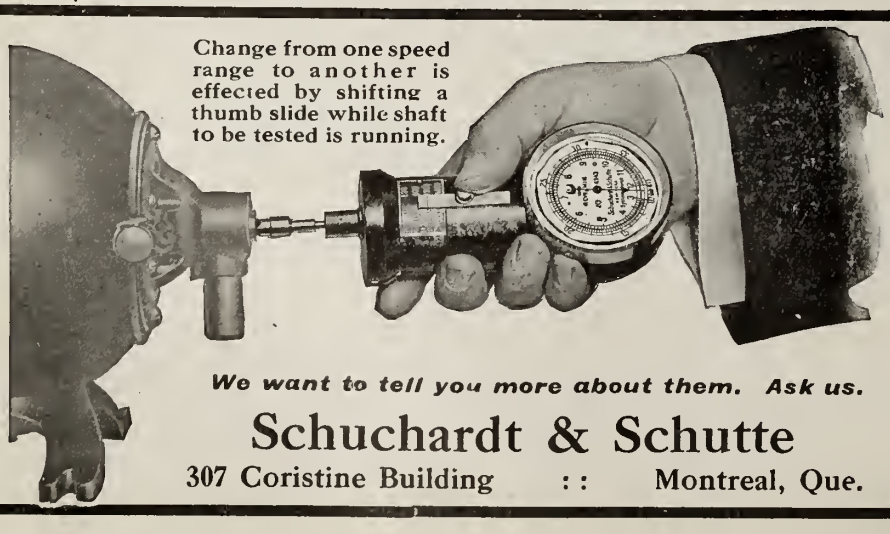

Change from one speed range to another is effected by shifting a thumb slide while shaft to be tested is running.

Do You Guess, or Do You Know

the capacity of your machines?

S & S Tachometers

tell you instantaneously and indicate accurately. No calculating or timing with a watch.

We want to tell you more about them. Ask us.

Schuchardt & Schutte

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Don't fail to examine the Main Switchboard in the Chateau Laurier.

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THE HILL ELECTRIC SWITCH & MFG. CO., Limited
MONTREAL

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MONTREAL CANADA

Bare and Insulated Electric Wire
Electric Light Line Wire. Incandescent or Flexible Cords.

Railway Feeder and Trolley Wire
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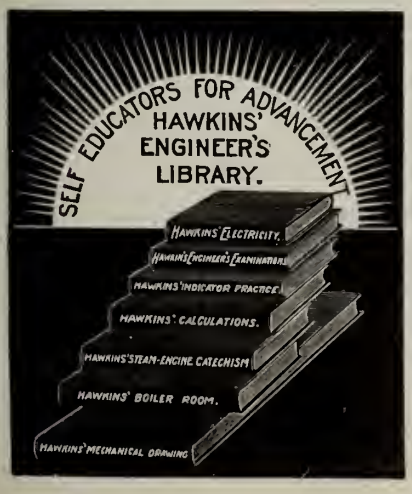

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Hydro-Proof Black Tape

We absolutely guarantee it to be a perfectly water-proof, acid-proof, alkali-proof insulator—yet it

Contains No Rubber

It is always flexible, and is unaffected by changes in temperature—will not dry out, harden or crack open.

It is specially prepared for high-voltage line works, will not corrode copper or other metals, and is the only type successfully used for submarine work.

We want you to prove its worth by actual service—write to-day for a half-pound sample roll, and give it the severest tests you can think of.

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The Hydro Tape Co. - Detroit, Mich.

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(Tungsten Filament)

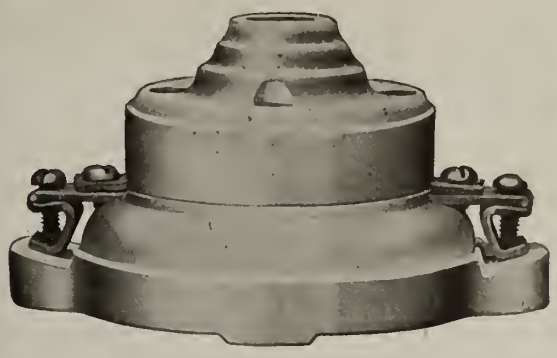
THE UNBREAKABLE KIND

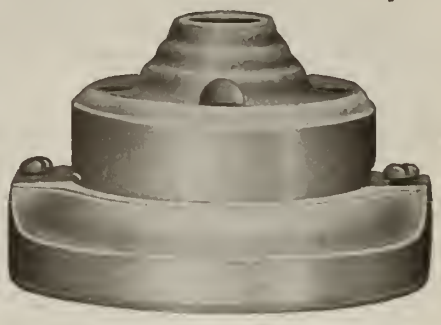
Are now ready for delivery. We guarantee delivery to you in good condition.

EXCLUSIVE CANADIAN DISTRIBUTOR:

P. H. KLEIN, Jr., CO.

Live Agents wanted all over Canada. 329 Craig Street West MONTREAL





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Manufactured

and

Carried in Stock

BY

MONARCH ELECTRIC CO., Limited

ST. LAMBERT, P.Q.

District of Montreal.

The advertiser would like to know where you saw his advertisement—tell him.

Albany Grease

All Lubricant—No Waste

Made of nothing but the purest materials which possess the highest friction-reducing qualities.

It does not drip, splash or waste away.

Look for trade-mark when you ask for **Albany Grease.** It means the end of your lubricating troubles.

At your dealer—if not, order direct.

ALBANY LUBRICATING COMPANY,
ADAM COOK'S SONS, PROPS.
708-710 Washington Street, New York

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We are the largest firm in Canada making a specialty of the production of **Sanitary Cotton Wiping Cloths** by a new up-to-date process.

We are supplying the largest manufacturing plants, power houses and machine shops throughout the Dominion.

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We also are manufacturers and large importers of cotton and wool waste. We can quote the very best prices.

Prices and samples of both waste and wipers sent free on request.

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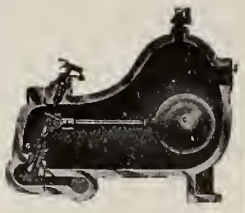
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
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Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

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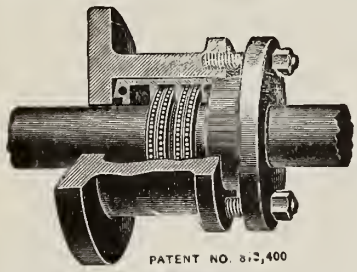

PATENT NO. 812,400

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HOLMES'
Metallic Packing
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Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

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A Unit saved from the exhaust is worth two in the coal pile.

WAINWRIGHT WATER HEATERS
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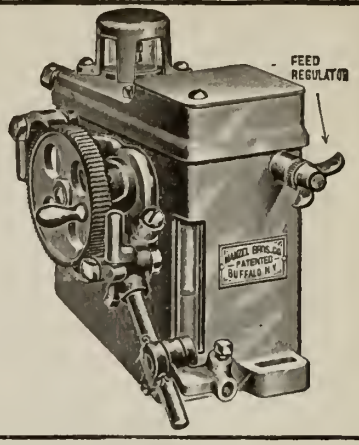

30% OIL SAVING GUARANTEED

You may be able to save as high as 60%. Many others have done so. The "Manzel" New Model Oil Saving Oil Pump is a positive lubricator. It oils the cylinders right all the time, and makes a big reduction in oil bills, besides saving labor and wear and tear on the engine.

You can try a "Manzel" Pump with the distinct understanding that it may be returned at our expense if it doesn't reduce your oil bills at least 30%.

Send for one on these conditions. Catalogue on request.

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will cure your troubles.

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The Detroit Lubricator Company maintains an engineering department that is at the service of users of lubricating devices. It is our aim to assist every owner of a Detroit Lubricator to get the greatest efficiency from it.

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Largest manufacturers of lubricating devices in the world.

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Scandinavia Belting is very largely used for conveyor belts, both for light materials and for heavy and sharp materials. We have different grades of Scandinavia Belting for the different purposes. The above illustration shows a conveyor belting in a large department store in Toronto. There is nearly a mile of this belting in use in this one place.

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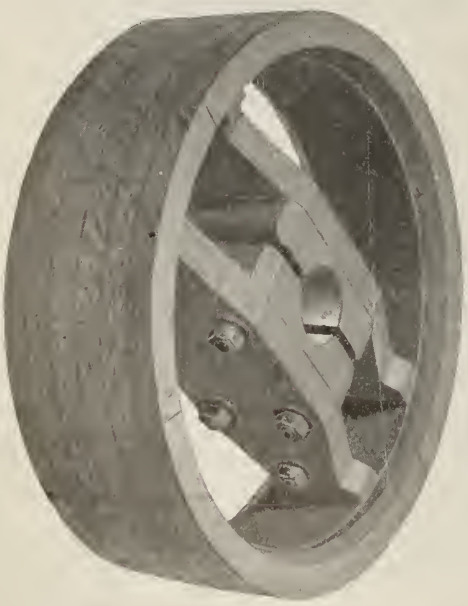

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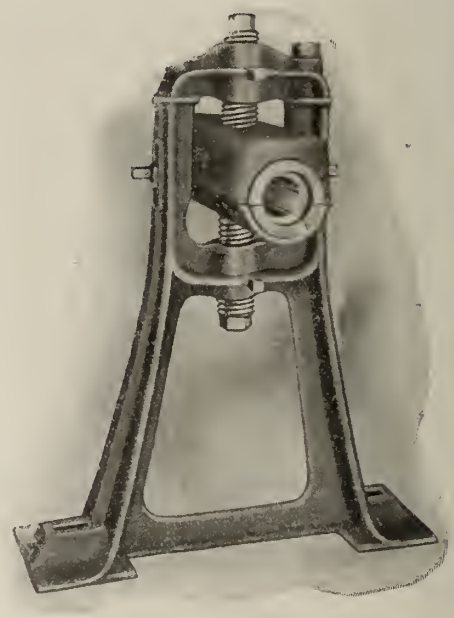
The Elmira B. & S. Hangers are designed to meet the hardest and most exacting conditions. They are of good weight, correct design, and well proportioned. A Duplex system of oiling is employed consisting of tempered steel rings and woven cotton wick.

The Elmira Pulley is built to stand the hardest service and most severe conditions. The rim is nailed throughout. The arms are tenoned into the rim and dowelled there. The pulley is guaranteed to run wherever a leather belt will give satisfaction.

Send for our Illustrated Catalogue "C."



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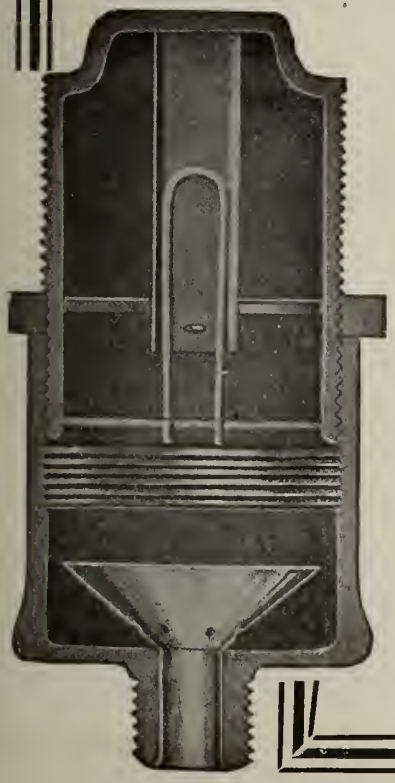
when it is properly made and used in our "PHILADELPHIA" Compressed Air Grease Cup, because there is absolutely no waste to contend with and the Grease is under perfect control until the last drop is used.

Oil used on machinery cannot be controlled, resulting in a constant dripping that means a loss of money to the user.



Why permit this loss to continue when at very little cost you can secure a perfect lubricator that will save time, money and labor—a lubricator that requires no attention after it is once filled.

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Give the "PHILADELPHIA" a trial—we guarantee it to save 50% over any other lubricating system.

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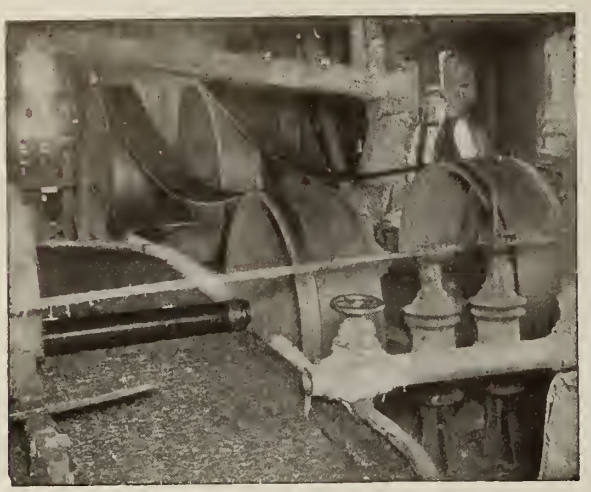

You Can Almost SEE MOISTURE in This Plant, But the Belts Treated With Cling-Surface Aren't Affected

This photograph shows two drive belts in the Toledo Binders & Trunk Board Mill, Toledo, Ohio, where wet pulp is abundant and the atmosphere filled with moisture.

These are good, heavy, painted cotton Gandy belts 12 in. wide, connecting 72 in. and 48 in. pulleys, 14 ft. between centres, each carrying 40 h.p. and running 27 in. slack. The line drawing shows very clearly the slack and increased contact-areas possible only with Cling-Surface treatment.

Painted cotton belts are usually waterproof when new, owing to the filler in them, but inside filler soon dries and cracks more or less and unless the belt is treated with Cling-Surface, water easily get in. The belts shown have been run and treated with Cling-Surface since 1900. They are to-day pliable, waterproof, show no minute openings in the surface and are in the best possible condition.

Cling-Surface treatment of any fibrous belts, leather, cotton, camel's hair, etc., not only makes them more pliable and waterproof but actually improves their durability, makes them capable of transmitting power without slip, with increased efficiency and with little attention.

You know what trouble tight, untreated belts cause in any plant; the constant adjustments and repairs necessary, the friction and slippage losses, the irregular and interrupted service and the worry that goes with them.

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We have literature and hundreds of testimonials that will interest you, but nothing will convince you as thoroughly as a fair trial on your most troublesome belt drives. Try Cling-Surface or at least tell us your conditions.

Cling-Surface Co

1057 Niagara Street Buffalo N Y

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Only SERVICE Counts

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and

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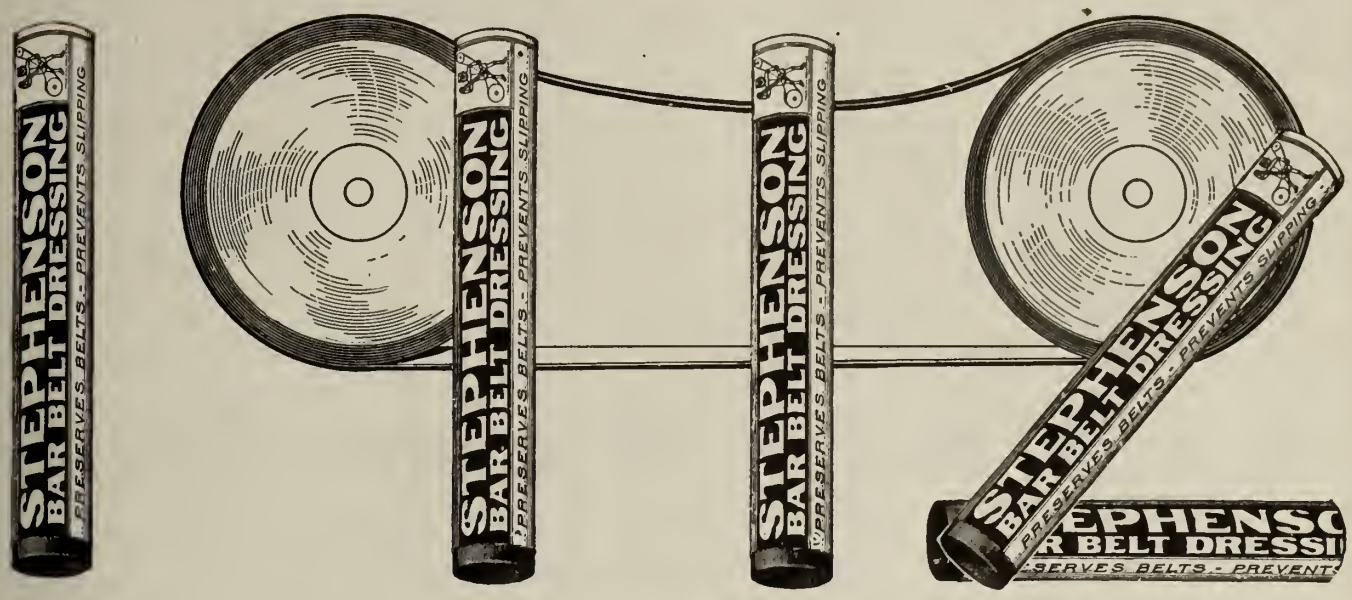

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Make 1912 a record breaking year. Turn over a new leaf and get rid of the things that have been causing needless trouble and expense. Adopt the things which will make your work easier, give better results and save money for your employer. You cannot start at a better place than with your belt dressing.

Get rid of your troublesome liquid dressing. Shake the can for the Stephenson solid stick and shake trouble at the same time.

Stephenson Bar Belt Dressing is a friend in need. It doesn't require preparation, nor do you have to use special care in applying it. The minute the belt slips you hold the Stephenson bar to the belt for a few seconds and the slipping stops. There's no waste—no slop—no smearing on of paste or pouring on of spattering liquid. And the results are better.

I'll "Stick to the Solid Stick"

Start With a Free ½ Lb. Sample

Simply send us your name and address and we'll send you a present in the shape of a free half-pound sample of Stephenson Bar Belt Dressing.

Remember—we give you this sample absolutely free of charge. Get this free half-pound of the finest belt dressing made and test it. Here's your chance to try somesomething really good at no expense.

None Genuine Without Trade-Mark

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THE BABBITT METAL WITHOUT A FAULT

It is doubly copper hardened.
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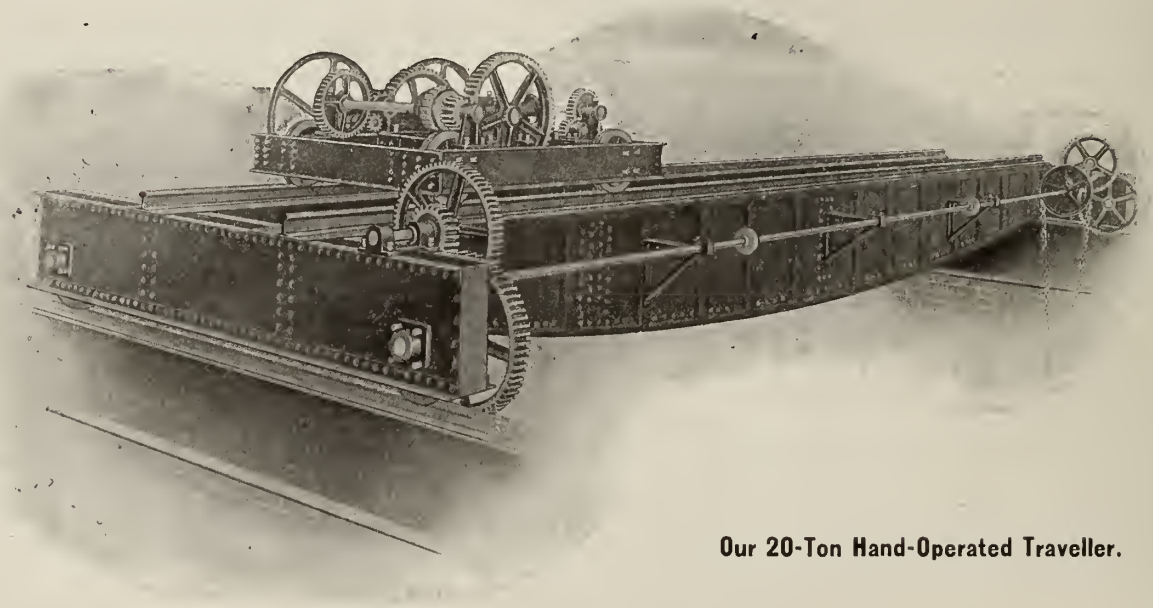
ALL TYPES **CRANES** **ALL SIZES**



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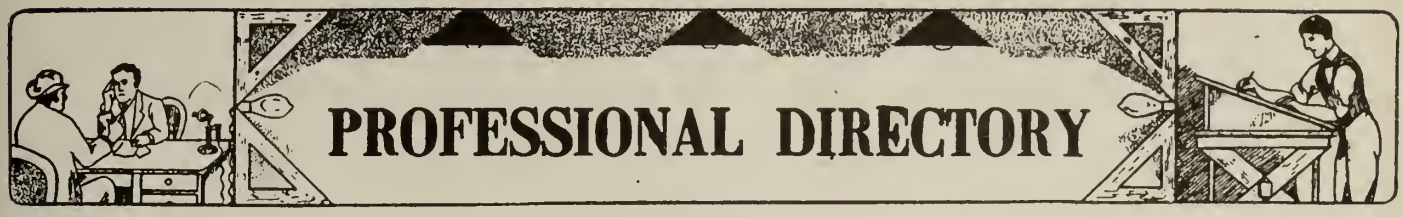

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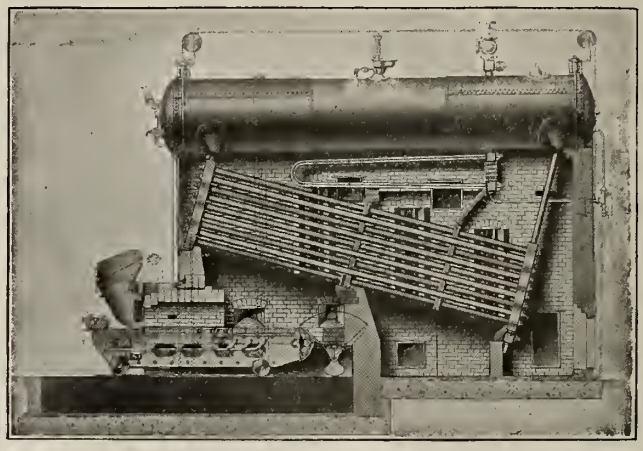

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Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
H. L. Peiler & Co., Montreal.
Hare Eng. Co., Toronto.
Waterous Engine Wks. Co., Brantford

Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Condensation Receiver.
G. M. Davis Regulator Co., Chicago.

Conduits.
E. Leonard & Sons, London, Ont.
Can. H. W. Johns-Manville Co., Toronto.

Consulting Engineers.
H. H. Angus, Toronto.
Bayfield & Archibald, Vancouver, B.C
de Gaspe Beaubien, Montreal.
Rowland Brittain, Vancouver, B.C.
W. N. Dietrich, Montreal.
John T. Farmer, Montreal.
Fetherstonhaugh & Co., Montreal.
Walter J. Francis, Montreal.
E. J. Greenstreet, Toronto.
Hare Eng. Co., Toronto.
Laurie & Lamb, Montreal.
Pratt & Ross, Toronto.
J. M. Robertson, Montreal.
J. M. Shanly, Montreal.

Contractors, Structural Steel.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canada Fdry. Co., Ltd., Toronto.

Conveyor Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Waterous Engine Wks. Co., Brantford

Cooler Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Cooling Towers.
Alberger Condenser Co., New York.

Copper Rods.
Standard Underground Cable Co., Hamilton, Ont.

Cork Insulation.
Can. H. W. Johns-Manville Co., Toronto.

Cotton Hose.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co. of Canada, Toronto.
Quaker City Rubber Co., Philadelphia, Pa.

Couplings.
Canadian Boving Co., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Dunlop Tire and Rubber Goods Co., Toronto.
Elmira Machinery and Transmission Co., Elmira.
General Supply Co. of Can., Ottawa.
Goodyear Tire & Rubber Co. of Canada, Toronto.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
J. C. Wilson & Co., Glenora, Ont.

Cranes, Electric.
Babcock & Wilcox, Montreal.
Canada Fdry Co., Ltd., Toronto.

Crank and Crosshead Pin Oilers
Lunkenheimer Co., Cincinnati, O.

Crushing Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canada Foundry Co., Ltd., Toronto.

Damper Regulators.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago, Ill.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
H. L. Peiler & Co., Montreal.

Doors, Cold Storage and Freezer.
Jones Cold Store Door Co., Hagerstown, Md.

Drying Machinery.
Can. Fairbanks-Morse Co., Montreal.

Dynamos.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Economizers.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.

Ejectors.
Jas. Morrison Brass Mfg. Co., Toronto.

Electric Fans.
Canadian General Electric Co., Ltd., Toronto.

Electrical Accessories and Machinery.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Canadian H. W. Johns-Manville Co., Toronto.
General Machinery Co., Toronto.
Northern Electric & Mfg. Co., Limited Montreal.

Elevating Machinery.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Engineers' Supplies.
Jas. Morrison Brass Mfg. Co., Toronto.

Engines, Automatic and Drop Valve.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Gas and Gasoline.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto
Canadian Westinghouse Co., Hamilton.
General Machinery Co., Toronto.
General Supply Co. of Canada, Ottawa
International Harvester Co. of America, Chicago.
Keighley Gas Engine Co., Keighley, Eng.
E. Leonard & Sons, London, Ont.

Engines, High Speed, Steam.
Canadian Boving Co., Toronto.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Marine.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
General Supply Co. of Canada, Ottawa
E. Leonard & Sons, London, Ont.
Laurie & Lamb, Montreal.

Engines, Saw Mill.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Single, Compound and Triple Expansion.
Canadian Boving Co., Toronto.
Douglas-Milligan, Ltd., Montreal.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Kerr Engine Co., Walkerville.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Vertical.
International Harvester Co. of America, Chicago.
General Supply Co. of Canada Ottawa
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.

Exhaust Fans.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.

Exhaust Heads.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Douglas-Milligan, Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
Steam Appliance Co., Milwaukee, Wis.
Watson & McDaniel Co., Philadelphia

Expansion Joints.
Alberger Condenser Co., New York.
Lunkenheimer Co., Cincinnati, O.

Feed Water Alarms.
H. L. Peiler & Co., Montreal.

Feed Water Analyser.
Dearborn Drug and Chemical Works, Chicago.
C. C. Snowdon, Calgary.

Feed Water Heaters.
Alberger Condenser Co., New York.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Douglas-Milligan, Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Goulds Pump Co., Montreal.
Hare Eng. Co., Toronto.
National Pipe Bending Co., New Haven, Conn.
H. L. Peiler & Co., Montreal.
Robb Engineering Co., Amherst, N.S.
The Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Canada Foundry Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.

Filters, Pressure.
Douglas-Milligan, Ltd., Montreal.

Fire Hose.
Dunlop Tire and Rubber Goods Co., Toronto.
Goodyear Tire & Rubber Co. of Canada, Toronto.
Quaker City Rubber Co., Philadelphia, Pa.

Fire Brick.
Alex. Gibb, Montreal.

Fireproof Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Flanges.
Dart Union Co., Toronto.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.

Flue Brushes.
General Supply Co. of Canada, Ottawa
Steam Appliance Co., Milwaukee, Wis.

Flumes, Steel.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
E. Leonard & Sons, London, Ont.

Freezer Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Furnace Linings.
Hare Eng. Co., Toronto.

Fuses.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto.

Gaskets, Rubber, Asbestos and Copper.
Can. Gasket Co., Bridgeburg, Ont.
Goetze Gasket & Packing Co., New Brunswick.
Asbestos & Rubber Goods Co., Toronto.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Dunlop Tire and Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Canada, Ottawa

Gas Exhausters.
Hare Eng. Co., Toronto.

Gas Producer Plants.
Canadian Boving Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
E. Leonard & Sons, London, Ont.

Gauge Cocks.
Can. Fairbanks-Morse Co., Montreal.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
H. L. Peiler & Co., Montreal.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

Gauge Test Pumps.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.

Gauges—Pressure, Vacuum, Draft and Recording.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.
H. L. Peiler & Co., Montreal.

Gears, Cut, Worm, Mortise.
J. C. Wilson & Co., Glenora, Ont.

Gears, Spur Level.
Manitoba Bridge & Iron Works Limited, Winnipeg.
J. C. Wilson & Co., Glenora, Ont.

Generators.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal.

Governors, Water Wheel
J. C. Wilson & Co., Glenora, Ont.

Graphite.
Jos. Dixon Crucible Co., Jersey City.
General Supply Co. of Canada, Ottawa
C. C. Snowdon, Calgary.

Graphitol.
British Pacific Supply Co., Victoria, B.C.

Grates.
Babcock & Wilcox, Montreal.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.

Grease Cups.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
Detroit Lubricator Co., Detroit.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
F. J. Schuch, Toronto.

Grease and Oil Extractors.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canada Foundry Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary.
Hare Eng. Co., Toronto.
Steam Appliance Co., Milwaukee, Wis.

Greases.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria, B. C.
Can. Fairbanks-Morse Co., Montreal.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Hangers.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Heaters.
Alberger Condenser Co., New York.
Canada Foundry Co., Toronto.
Darling Bros., Montreal.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Hare Eng. Co., Toronto.
E. Leonard & Sons, London, Ont.
H. L. Peiler & Co., Montreal.
The Stewart Heater Co., Buffalo, N.Y.

Hose, Flexible Metallic.
F. J. Schuch, Toronto.

Hose, Steam, Suction and Water.
Asbestos & Rubber Goods Co., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
Goodyear Tire & Rubber Co., Toronto

Hydraulic Accumulators.
Canada Foundry Co., Ltd., Toronto.

Hydraulic Machinery.
The Deming Co., Salem, O.

Hydro Extractors.
Jones & Glassco, Montreal,

Ice Making Machinery.
Linde British Refrigeration Co., Montreal.

Indicators, Electric—All Types.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Indicators, Steam and Gas Engine.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Can. Fairbanks-Morse Co., Montreal.
H. L. Peiler & Co., Montreal.

Indicators—Ammonia, Hydraulic.
Am. Steam Gauge & Valve Mfg. Co., Boston, Mass.
Detroit Lubricator Co., Detroit.

Injectors.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.

Insulating Compounds.
Standard Underground Cable Co., Hamilton, Ont.

Insulating Tapes & Varnishes.
Standard Underground Cable Co., Hamilton, Ont.

Iron Filler.
Imperial Waste & Metal Co., Montreal.

Lamps, Tungsten, etc.
Canadian General Electric Co., Ltd., Toronto.

Lamps, Arc, Incandescent.
Canadian General Electric Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton
P. H. Klein, Jr., Co., Montreal.
Northern Electric & Mfg. Co., Limited, Montreal.
A. H. Winter Joyner, Toronto.

Lubricants.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria, B. C.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Lubricators, Force Feed.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
Darling Bros., Montreal.
Detroit Lubricator Co., Detroit.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N.Y.

Lubricators, Plain.
Detroit Lubricator Co., Detroit.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.

Mats.
Dunlop Tire & Rubber Goods Co., Toronto.
Goodyear Tire & Rubber Co. of Canada, Toronto.

Mechanical Stokers.
Babcock & Wilcox, Montreal.
Hare Eng. Co., Toronto.
Murphy Iron Works, Detroit, Mich.

Meters, Electric.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Meters, Water.
H. L. Peiler & Co., Montreal.

Mill and Mining Machinery.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
Jenckes Machine Co. Sherbrooke, Que
Madison Williams Mfg. Co., Lindsay, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Motors.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal.

Motor Starters and Controllers.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Office Railings.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Cups.
Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, O.

Oil Filters.
Canadian Oil & Waste Saving Machine Co., Ltd., Brockville.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Separators, Ammonia.
Steam Appliance Co., Milwaukee, Wis.

Oil Separators.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Liberty Mfg. Co., Pittsburg.
Jas. Morrison Brass Mfg. Co., Toronto.
Steam Appliance Co., Milwaukee, Wis.

Oils, Lubricating.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria, B. C.
Can. Oil Companies, Ltd., Toronto.
Dearborn Drug and Chemical Works, Chicago.
C. C. Snowdon, Calgary.

Packing Engine.
Asbestos & Rubber Goods Co., Toronto.
Can. H. W. Johns-Manville Co., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Canada, Ottawa
Goodyear Tire & Rubber Co. of Canada, Toronto.
Steel Mill Packing Co., Windsor, Ont.

Packing, Metallic.
Asbestos & Rubber Goods Co., Toronto.
General Supply Co. of Canada, Ottawa
Holmes Metallic Packing Co., Wilkesbarre, Pa.
H. L. Peiler & Co., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.
Rhodes Improved Metallic Packing Co., Ltd., Montreal.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Asbestos & Rubber Goods Co., Toronto.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
General Supply Co. of Canada, Ottawa
Goodyear Tire & Rubber Co. of Canada, Toronto.
Steel Mill Packing Co., Windsor, Ont

Packing, Sheet.
Asbestos & Rubber Goods Co., Toronto.
Dunlop Tire & Rubber Gods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
General Supply Co. of Canada, Ottawa
Goodyear Tire & Rubber Co, of Canada. Toronto.
Quaker City Rubber Co., Philadelphia, Pa.
F. J. Schuch, Toronto.

Packing, Ammonia, Steam and Water.
Asbestos & Rubber Goods Co., Toronto.
Canadian H. W. Johns-Mansville Co., Toronto.
Dunlop Tire and Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
General Supply Co. of Canada, Ottawa
Goodyear Tire & Rubber Co. of Canada, Toronto.
Quaker City Rubber Co., Philadelphia, Pa.
F. J. Schuch, Toronto.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rubber.
Dunlop Tire and Rubber Goods Co., Toronto.

Paints.
Can. Oil Companies, Ltd., Toronto.

Panel Boards.
Devoe Electric Switch Co., Montreal.
Hill Electric Switch Co., Montreal.

Packing Rubber.
Dunlop Tire and Rubber Goods Co., Toronto.
Goodyear Tire & Rubber Co., Toronto

Penstocks.
Canada Foundry Co., Ltd., Toronto.
Canadian Booving Co., Toronto.

Penstock Lugs.
Otterville Mfg. Co., Otterville, Ont.

Pillow Blocks.
Elmira Machinery & Transmission Co., Elmira, Ont.
J. C. Wilson & Co., Glenora, Ont.

Pipe Coils.
National Pipe Bending Co., New Haven, Conn.

Pipe Cutting and Treading Machine and Tools.
Can. Fairbanks-Morse Co., Montreal.
Curtis & Curtis Co., Bridgeport, Conn

Pipe, Steel.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
E. Leonard & Sons, London, Ont.

Pipe (Second-Hand).
Imperial Waste & Metal Co., Montreal.

Pipes, Water.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Pacific Coast Pipe Co., Vancouver, B. C.

Piping and Fittings.
Jas. Morrison Brass Mfg. Co., Toronto.

Piping, Steam.
Babcock & Wilcox, Montreal.
Imperial Waste & Metal Co., Montreal.

Planimeters.
H. L. Peiler & Co., Montreal.

Plate Work.
Canada Foundry Co., Ltd., Toronto.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

Polish, Metal.
G. W. Hoffman, Indianapolis.

Power Pumps.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
Deming Co., Salem, O.
General Machinery Co., Toronto.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Goulds Pump Co., Montreal.
E. Leonard & Sons, London, Ont.

BOILER SETTINGS THAT LAST

"GLENBOIG"

FIREBRICK HAVE STOOD THE TEST

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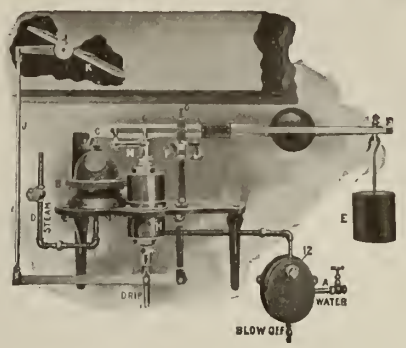

With a

Stillman-Carmichael Damper Regulator.

The SAVING effected in FUEL by the installation of this Regulator will vary from 5 to 18% and the first cost is very small.

It will regulate High and Low pressure STEAM BOILERS, Blowers and Pumping Engines.

One Regulator will govern one or more Boilers. It will close or open wide the damper or dampers on a variation of ONE POUND of Steam.

We furnish these Regulators subject to 30 days' trial.

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Winnipeg, Man. St. John, N.B. Toronto, Ont.

Potato Scale Boiler Cleanser

Works With Certainty

Send me a gallon of your feed water, we will analyze it and mix you a compound that will not only remove old scale, without the slightest injury to the tubes, but will prevent any fresh scale from forming.

Give it a fair trial and if it doesn't do what I claim, I will cancel the charge for the amount.

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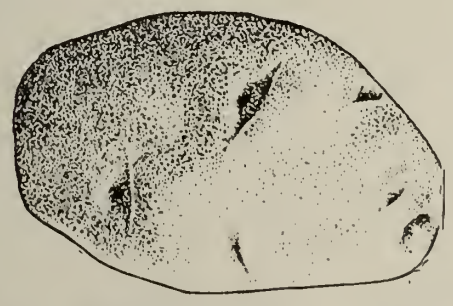

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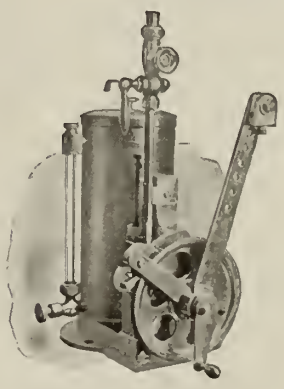

FOR STATIONARY ENGINES, STEAM PUMPS, HYDRAULIC ELEVATORS. GAS ENGINES, AIR COMPRESSORS, ICE MACHINES.

The Rochester Force Feed Lubricator is a PERFECT DEVICE that has modernized the force feed system of pumping oil automatically under all conditions. If you are considering the installation of a new engine or change of equipment, why not let us send you a ROCHESTER FORCE FEED LUBRICATOR on 30 days' trial.

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Waterous Engine Works Co., Brantford.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.

Power Transmission Machinery.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery & Transmission Co., Elmira, Ont.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
The Stewart Heater Co., Buffalo, N.Y
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Pulleys.
Can. Fairbanks-Morse Co., Montreal.
Crescent Oil Co., Hamilton, Ont.
Elmira Machinery and Transmission Co., Elmira, Ont.
General Supply Co. of Canada, Ottawa
Manitoba Bridge & Iron Works Limited, Winnipeg.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Pulp Mill Machinery.
Escher, Wyss & Co., Toronto.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

Pumping Machinery.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Canada Foundry Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Deming Co., Salem, O.
General Machinery Co., Toronto.
General Supply Co. of Canada, Ottawa
Standard Eng. Co., Toronto.
Waterous Engine Works Co., Brantford.

Pnmp Governors and Regulators.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago, Ill.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.
Watson & McDaniel Co., Philadelphia.

Pump Strainers.
Canadian Steam Boiler Equipment Co., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.

Pumps, Air.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Canada Foundry Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Deming Co., Salem, O.
General Supply Co. of Canada, Ottawa
E. Leonard & Sons, London, Ont.

Pumps, Centrifugal.
Alberger Condenser Co., New York
A. W. Bennet, Toronto.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Deming Co., Salem, O.
Canadian Boving Co., Toronto.
Escher, Wyss & Co., Toronto.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

Pumps, Geared, Compound.
American Steam Pump Co., Battle Creek, Mich.
Canada Foundry Co., Ltd., Toronto.
Deming Co., Salem, O.
Can. Fairbanks-Morse Co., Montreal.
General Machinery Co., Toronto.
E. Leonard & Sons, London, Ont.

Pumps, Hydraulic, Pressure.
American Steam Pump Co., Battle Creek, Mich.
Canada Foundry Co., Ltd., Toronto.
The Deming Co., Salem, O.

Pumps, Oil.
The Deming Co., Salem, O.
Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, O.
Manzel Cros. Co., Buffalo, N.Y.
Michigan Lubricator Co., Detroit.

Pumps, Steam.
American Steam Pump Co., Battle Creek, Mich.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
The Deming Co., Salem, O.
Douglas-Milligan, Ltd., Montreal.
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Goldie & McCulloch Co., Galt.
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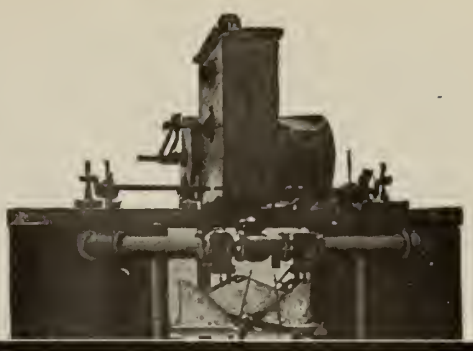

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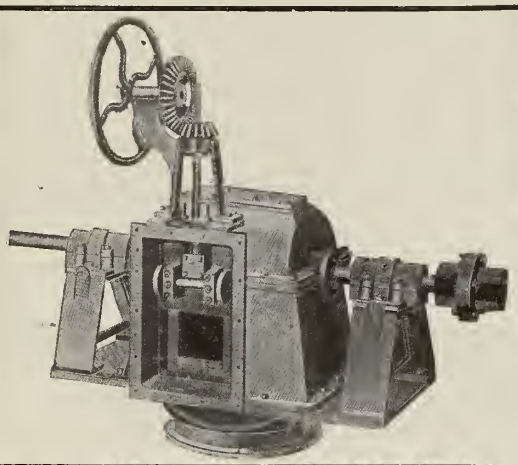

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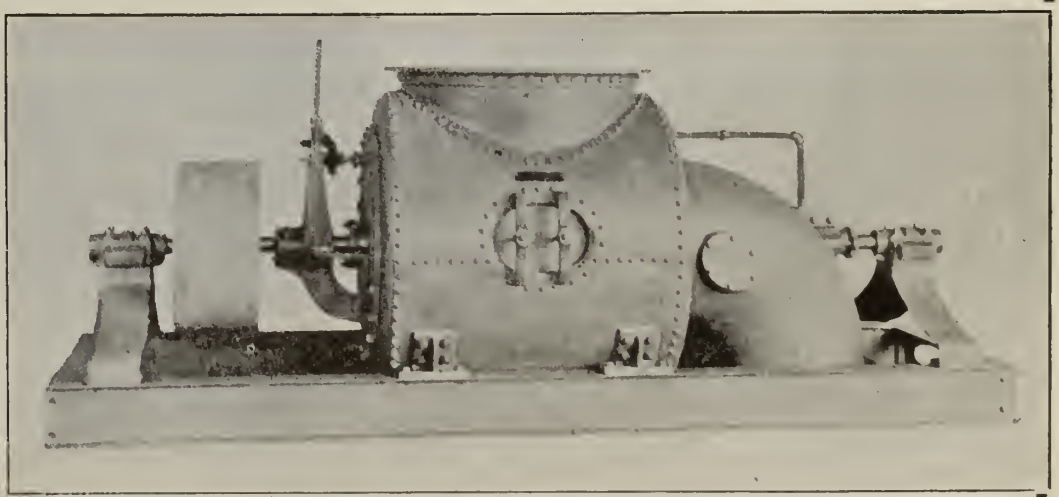

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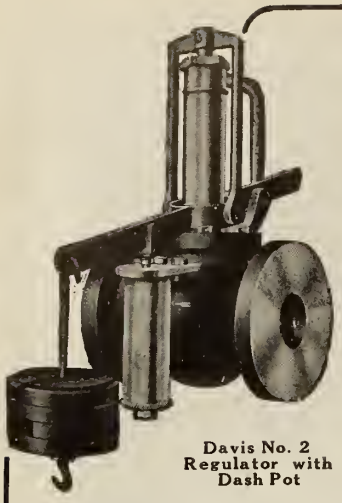

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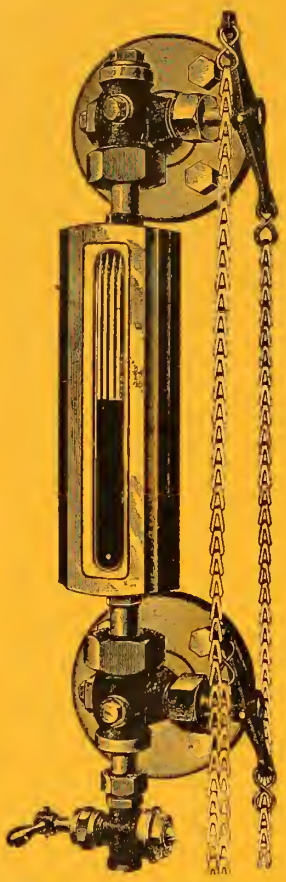
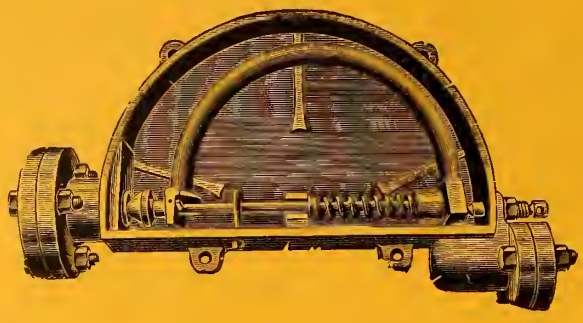


Heavy Type Water Gauge.
Mountings with Reflex Glass—non-breakable.



The "Heintz" Steam Trap
or Steam Saver—automatically prevents all waste of steam.

TRADE MARK J.M.T. REGISTERED A GUARANTEE OF QUALITY

Over 25 Years
of Perfect Service

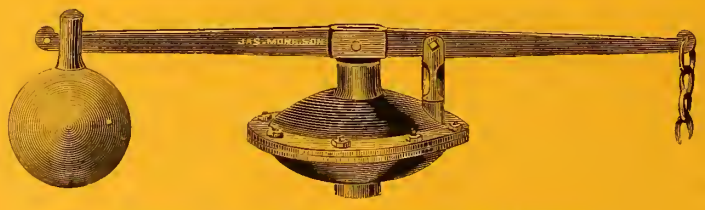
back this high grade line. Anything that we sell represents all that is best in quality, design and workmanshlp. We manufacture a large range of **Engineers' Supplies** and **Steam Specialties** in brass and iron on which we quote prices that are right.

Write for full particulars.

Catalog to the trade.

J.M.T. Improved Injector.

J.M.T. Pop Safety Valve
Made Flanged and Screwed.



Standard Low Pressure Damper Regulator.

The James Morrison Brass Mfg. Co., Ltd.

93-97 Adelaide Street West - TORONTO

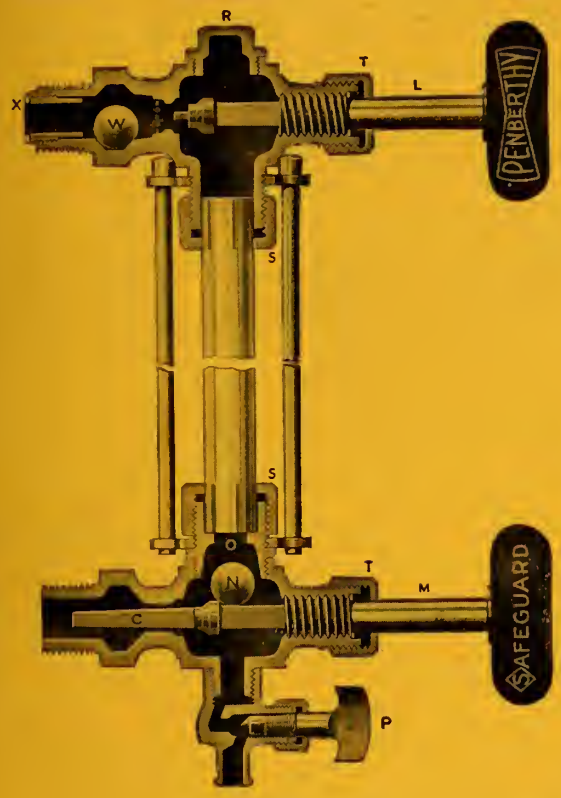
Special Feature—Convention News

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-149 University Ave. LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. V. Publication Office, Toronto—July, 1912 No. 7



THE SAFEGUARD

WILL GUARD

YOUR SAFETY

A Positive, Simple, Reliable, Automatic Water Gage

AN EXPLANATION THAT WILL APPEAL TO ALL ENGINEERS.

The action of the Safeguard Automatic Water Gage is perfect in operation and therefore gives positive protection.

¶ FIRST. *The Upper Ball Seat* of the "Safeguard" is purposely constructed to leak a small amount of dry steam; so slight, that when the glass is broken, it can injure no one, serving at this time only to call attention to the break. It is, however, sufficiently large to keep the balls from seating *unless the glass is broken.* It does this by quickly equalizing the pressures in the gage glass and boiler, after a new glass is inserted. This prevents the balls from seating, as their own weight automatically drops them to their normal resting places the instant the pressures are equal. *This leak is positively necessary to insure the perfect operation of an automatic gage. It is the only means of preventing a false water level from being shown, and any gage not so constructed is, for that reason, unsafe.*

¶ SECOND. *The lower Ball Seat* is absolutely tight—when the glass breaks the released pressure instantly carries the lower ball up to its seat, not a drop of water being lost except that in the glass at the time of breaking. The danger of a false water level being shown, particularly through shutting the pet-cock, after the gage is blown, is overcome on the "Safeguard" by a pet-cock which is *slow-closing* and thus prevents the balls from being thrown to their seats, as is possible on all gages equipped with the old style cock which opens full on a half-turn. *This is a patented "Penberthy" feature and is used only on Safeguard Automatic Water Gages.*

¶ Another new and interesting feature about the "Safeguard" is the price.

¶ A gage made of the highest quality bronze, square, polished body, tested at from 2 lbs. to 300 lbs. and fitted with the Penberthy Patented Dripless Pet-Cock.

Manufactured by

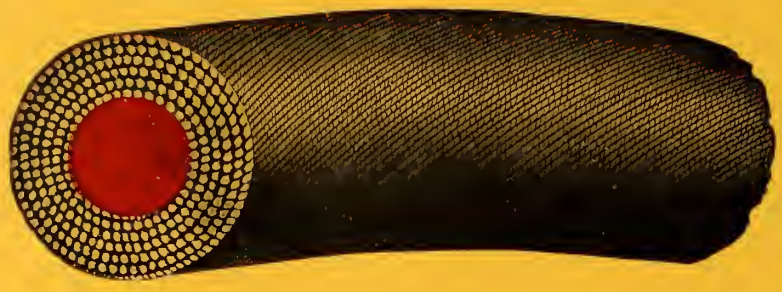
PENBERTHY INJECTOR CO., LIMITED, - - Windsor, Ont.

Makers of Strictly High Grade Brass Goods.

Peerless Piston and Valve Rod Packing

The great value of the famous Peerless Piston Packing lies in the fact that the core is made of

RAINBOW PACKING



It's Rainbow, Therefore It Holds

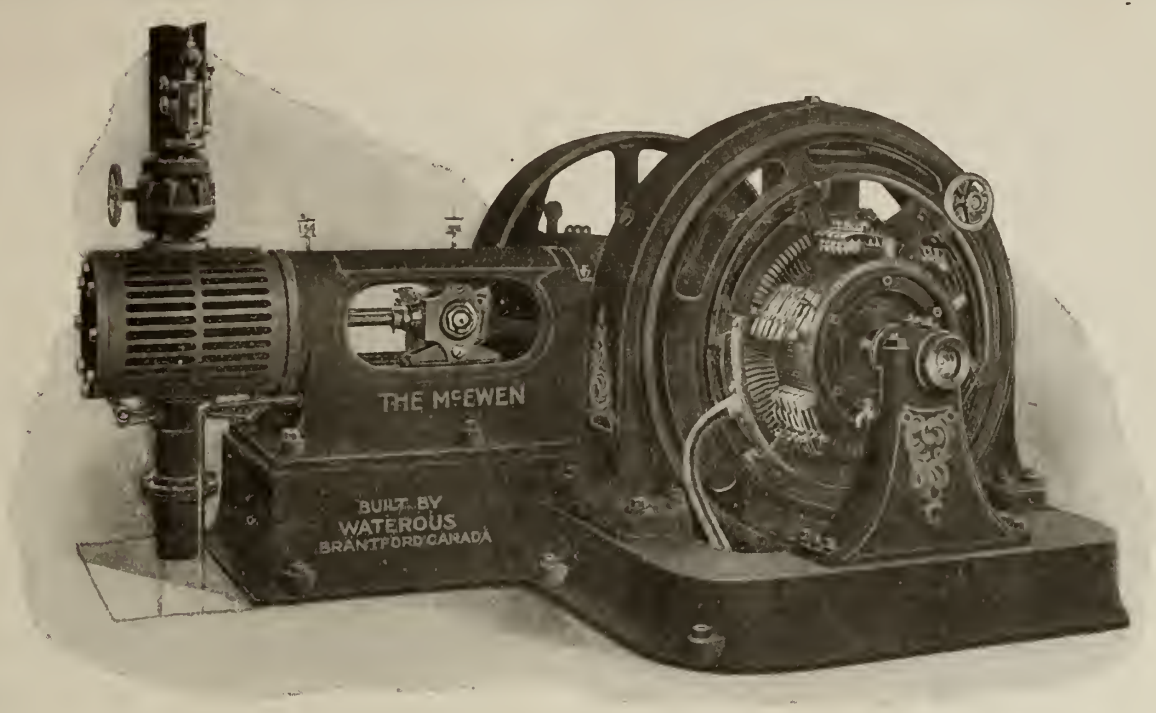
Others have tried to imitate our quality but the essential was not there, the Rainbow Core. It is the one packing that will not fail you.

PEERLESS RUBBER MFG. COMPANY

16 Warren Street, NEW YORK

H. D. EDWARDS & CO., Detroit, Mich.

Sole Agents and Distributors for the Dominion of Canada



Best Results per Dollar of Cost

Our Guarantee

"The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of the boiler pressure from the greatest to that necessary to do the work will not reduce the speed of the engine one revolution. Any engine failing to meet this guarantee becomes the property of the purchaser upon the payment of one dollar."

In plain English this means—"Perfect engine regulation or your money back."

Hundreds of McEwen Engines have been sold by us in Canada.

We have never yet been asked to redeem this guarantee.

It is not a question of what an engine is worth per pound, but what kind of engine will give the greatest service and the best results per dollar of cost.

McEWEN HIGH SPEED AUTOMATIC ENGINES

are built and sold on a basis of quality—of economical operation, and of permanent satisfaction to the user.

The difference in initial cost as compared with the throttling type engine is quickly compensated for in greater ease of operation, in greater durability, in closeness of regulation, economy of steam consumption, and in the wide range of power at command.

Supplied in simple and compound units up to 700 Horse Power, the McEwen Engine makes an ideal installation for the efficient and economical generation of electric light and power.

The McEwen Engine is built for hard work. Absolutely simple, exceptionally strong, it is fitted with an automatic governor—the Begthrup—which has never been surpassed for closeness of regulation. Read our Guarantee.

Get the McEwen Booklet.

The Waterous Engine Works Co., Limited

BRANTFORD, CANADA.

The advertiser would like to know where you saw his advertisement—tell him.

GOODYEAR

Power-Saving Rubber Belting

Goodyear Rubber Belting stands for power saved and money saved. It is built up of plies of rubberized fabric cured and vulcanized into one solid piece. It neither slips nor stretches. It has the cohesiveness of rubber with the enormous tensile strength of close woven, long fibre cotton fabric from which ***all stretch has been taken out.***

Goodyear Rubber Belting is manufactured by a process that makes it proof against steam, water, weather and rot. Made in all three grades and all sizes. For Pulp, Paper, Saw Mills—*all* mills where horse power transmitted is large and demand for tensile strength great. Used by biggest lumber mills and manufacturing plants in the Dominion. *Outlives, outlasts* all other belts,

Rot-Proof Mill Fire Hose

Goodyear Underwriters is a hose built to meet the specifications of the Associated Factory Mutual Fire Insurance Companies. Tube used of highest grade NEW rubber. *Won't* harden or crack with age. Special circular woven fabric with least expansion or elongation under pressure. Antiseptically-treated to make it rot and mildew proof.

The strongest, most reliable hose for all mills and factories. Insist on *Goodyear Underwriters, the hose with the black and yellow stripes.*

Non-Chipping Conveyor Belts

Built for all purposes. For conveying crushed stone, grain, coal, ore, etc.

Made in all thicknesses of face to suit requirements of buyer. Rubber face made of toughest stock possible, to prevent cutting and chipping. Gives longest and most enduring service.

We also manufacture other rubber goods such as tires, all kinds of hose and belting, rubber packing, etc.

Write us to-night for catalog and prices.

Our sales of the last four months fifty per cent. greater than those of last year. Defective goods returned only $23.93

The Goodyear Tire & Rubber Company of Canada, Ltd.

General Offices—Toronto. Factory—Bowmanville, Ont.

11 ***Write Our Nearest Branch***

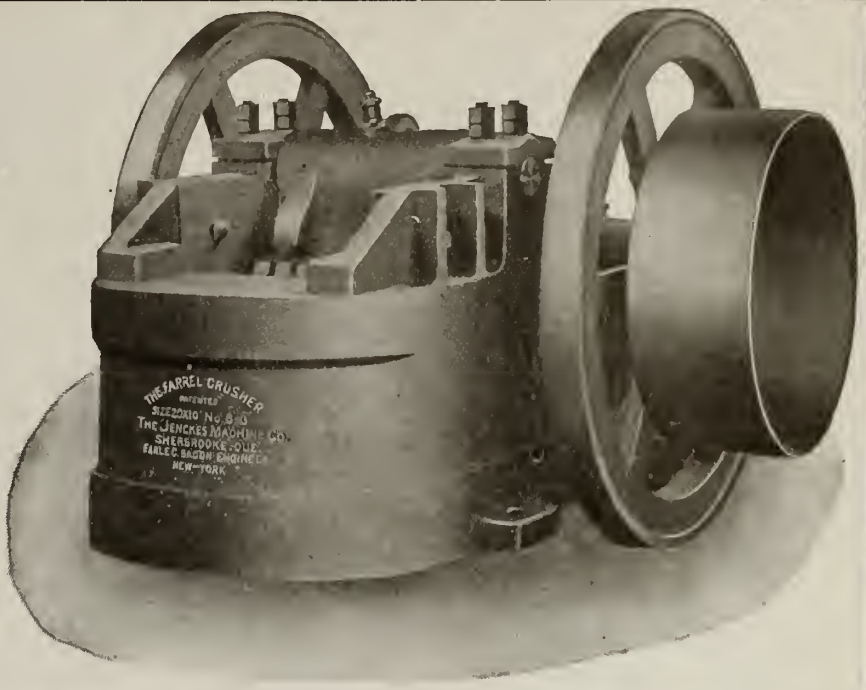
BRANCHES—Montreal—Winnipeg—St. John, N.B.—Vancouver—Calgary
Victoria, B.C., 855 Fort Street; Regina, Sask., 2317-2318 South Railway Street; Hamilton, Ont., 127 King Street West.

Crushing Machinery

Crushers, Crushing Rolls,
Fine Crushers
and Accessories.

Complete Crushing
and
Screening Plants,
including
Power Equipment.

Write for Catalog.



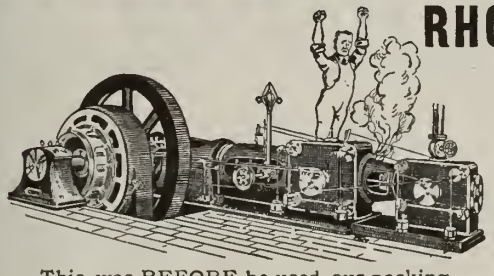
The Jenckes Machine Co., Limited

General Offices: Sherbrooke, Que.

Works: Sherbrooke, Que. St. Catharines, Ont.

Sales Offices:—Sherbrooke, St. Catharines, Montreal, Cobalt, So. Porcupine, Vancouver, Nelson.

RHODES IMPROVED METALLIC PACKING

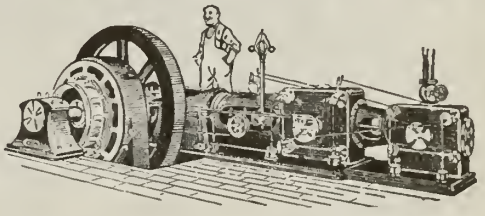


This was BEFORE he used our packing.

THE PACKING
THAT PACKS

A trial will convince you.

Beware of Imitations.



This is AFTER he installed our packing.

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited
55 St. Francois Xavier Street, - - - MONTREAL

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC
METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

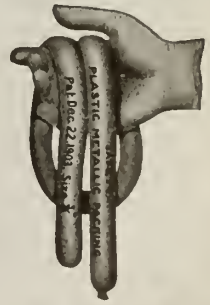
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

Practically Frictionless



Sold on APPROVAL

SAVE!

50 per cent. on Incandescent Lamps

Ten Cents

is the price at our factory, therefore

Buy Direct

We also offer **Special Contract Prices.** Ask for them.

Lamps 2, 5, 8, 10 and 16 candle power.

32 candle power at slight advance on above price.

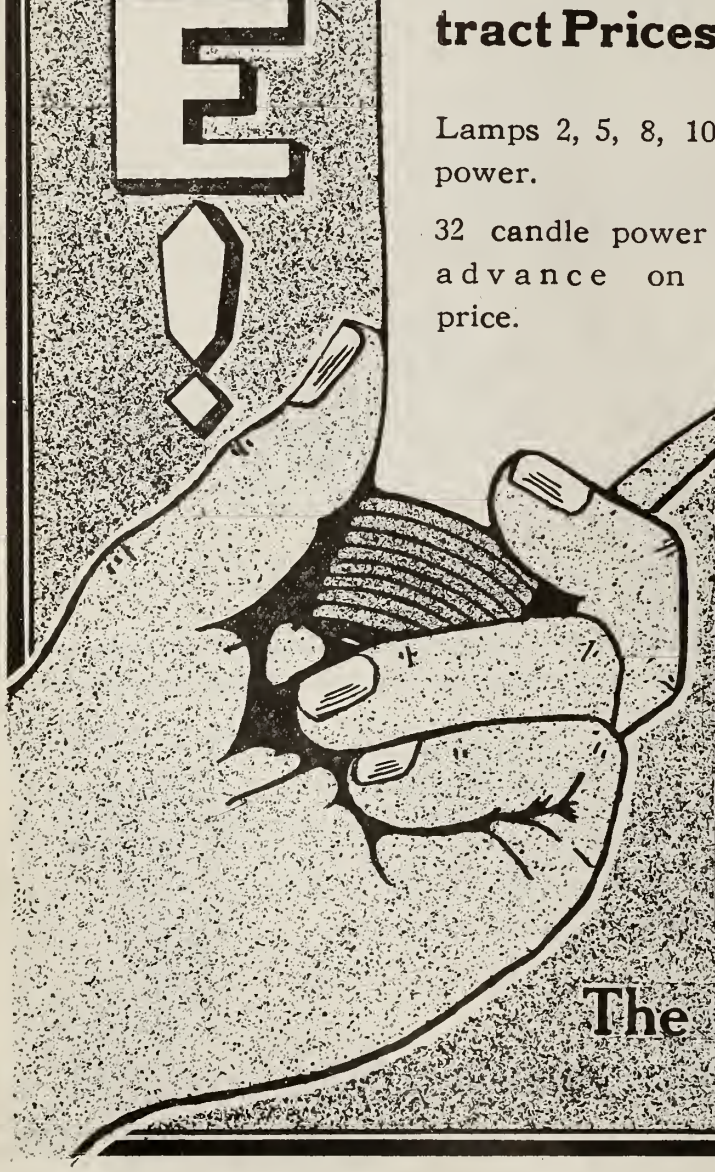
10c.

NOW

is the time to contract with us for your season's supply. All our lamps are as fully tested and guaranteed as any other Canadian made lamps.

Orders shipped promptly during rush season.

Good Discounts for Quantity.



The Dominion Electric Co.

St Catharines, Ont.

3000 Kw.—220 V.—D.C. Front View.

Northern Electric Switchboards

You must have QUALITY in a switchboard to insure satisfactory operation throughout its life.

We manufacture POWER SWITCHBOARDS of every description and equip our boards with the following apparatus of QUALITY:—

WESTON INSTRUMENTS
CONDIT OIL SWITCHES
CONDIT CIRCUIT BREAKERS
TAUNTON-NEW BEDFORD KNIFE SWITCHES

SLATE, MARBLE and all other accessories are selected with QUALITY as our only consideration. In addition the board is designed and built by experts.

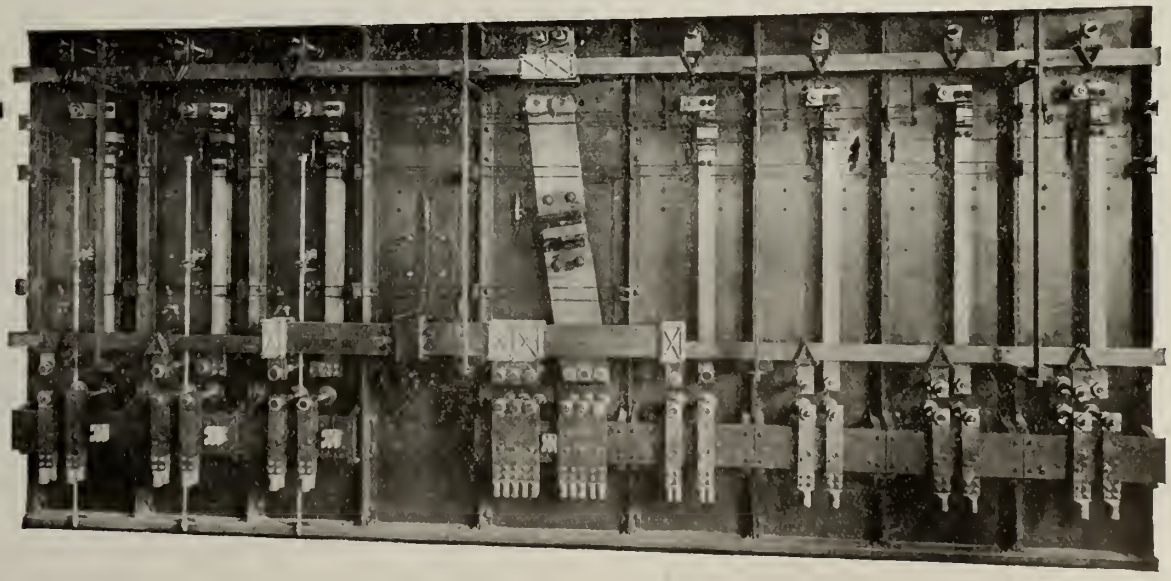
"NORTHERN ELECTRIC QUALITY" insures the elimination of trouble.

For full particulars address Desk 2071.

THE Northern Electric AND MANUFACTURING CO. LIMITED

Manufacturer and Distributor of Telephone Apparatus, Electrical Supplies, and Fire Alarm Apparatus for every possible need.

Address our nearest house: Montreal Toronto Winnipeg Regina Edmonton Calgary Vancouver



3000 Kw.—220 V.—D. C. Back View.

The advertiser would like to know where you saw his advertisement—tell him.

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY

Done Work Until Monday

Off go the overalls at quitting time Saturday and the engineer's Sunday is his own to spend in the park or under his own vine-clad arbor, smoking his "jimmy pipe," or in any other way he pleases, if he uses

Daniel's Rod Packing **P.P.P.**

THREE STYLES

"Regular," "Special" and "Marine." All styles are furnished in Coil, Spiral and Ring forms.

There's no Sunday work repacking the engine when P.P.P. is used. THREE rings will last for months in any engine, even if it is a "packing hog" and fairly "eats" ordinary packing.

It's friction that wears out rod packing. The reason that P.P.P. lasts so long is because it is practically frictionless. This is proved not only by the length of time P.P.P. lasts, but also by the saving of coal and oil. No power is wasted overcoming unnecessary friction, as P.P.P. automatically adjusts itself to any pressure from 2 lbs. to 200 lbs. The bearing on the rod is never in excess of the requirement.

FREE

TO ENGINEERS

The thousands of requests for our Engineer's Blue Book encourages us to offer an *entirely new* one, FREE.

The name of the book and a description of its contents will appear in the August or September issue of this magazine. Watch for it.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

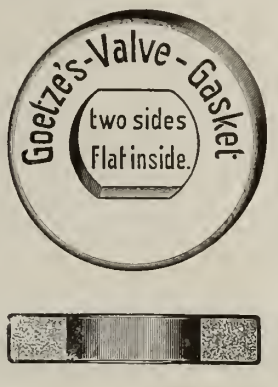
PHILADELPHIA CHICAGO PITTSBURGH NEW YORK

The advertiser would like to know where you saw his advertisement—tell him.

GOETZE'S VALVE GASKETS SAVE TROUBLE AND MONEY

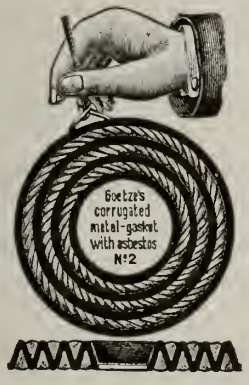
THEY ARE FOR VALVES OF THE JENKINS TYPE
AND ARE MADE OF COPPER AND ASBESTOS

One Goetze's Valve Gasket will outlast six rubber discs, because it will not crack and go to pieces as rubber does. That's why Goetze's Valve Gaskets are cheapest from beginning to end.



Order your new valves fitted with Goetze's Valve Gaskets and have no more trouble with leaks. Use Goetze's Valve Gaskets to give your old valves a new lease of life. Only be sure you get *Goetze's.*

That Joint That Gives You So Much Trouble Can Be Made *Tight*



To put a gasket on the least troublesome flange joint in your plant is no real test of the value of that gasket. Put it on the *worst* joint, the one that is always giving you trouble, and you'll find out whether it is any good for your purpose or not.

We tell you that you can put a complete stop to all trouble due to leaky flange joints, that you can make that joint which gives you so much trouble absolutely tight

By Using Goetze's No. 2 Gaskets

And we are willing to prove it to you by shipping you any quantity on *90 days' trial*—no charge if they do not make tight joints and *hold* them tight under all pressures and temperatures. Try them. Write us to-day what sizes and quantities to ship. Remember, they do not cost you a cent unless they do the work. And be sure to ask for a copy of our Illustrated Catalog of Packings for all Power Plant Purposes.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

St. John, N.B.

BRANCHES AT

MONTREAL
163 Esplanade Ave.

WINNIPEG
C. E. Chown, 147 Bannatyne Ave.

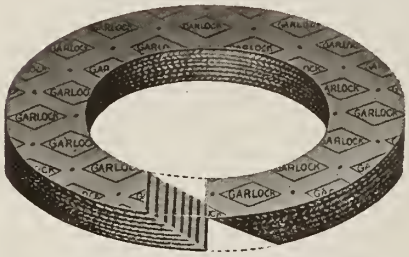
VANCOUVER
A. O. Campbell, 1069 Hamilton St.

MANUFACTURED BY

Goetze Gasket & Packing Co.

NEW BRUNSWICK, N.J.

GARLOCK

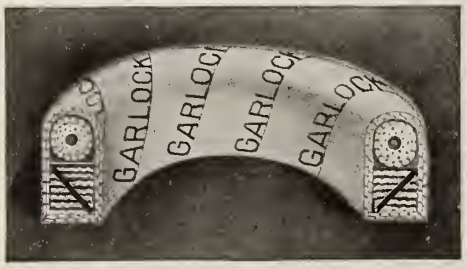


Garlock Regular Ring

Are the Standard

Remember:

It is the service which any Packing gives that determines its worth—not the price paid for it.



Garlock High Pressure Diagonal

Packings for all classes and conditions of service.

Garlock Gum Core

The Garlock

Head Office and Works:

BRANCHES: MONTREAL, QUE., 412 St. James Stre

"Pioneers in th

SEE US AT BELLI

PACKINGS

f Packing Economy

Special combination sets made up to suit cases of extraordinary or troublesome conditions.

Write for handsomely illustrated catalog, descriptive of Garlock Packings and Pipe-coverings.

TRADE THE GARLOCK PACKING CO. HAMILTON, CANADA. MARK

Garlock High Pressure Ring

Garlock Asbestos Gasket

Packing Co.

HAMILTON, ONT.

TORONTO, ONT., 77 Adelaide St. E. WINNIPEG, MAN., 117 Market St. E.

Packing Business."

NILLE CONVENTION

Garlock Regular Spiral

TRADE JENKINS MARK
Jenkins Bros.

TRADE JENKINS MARK
Jenkins Bros.

"It's just as easy to get the Genuine and so much easier after you have them."

Only one word may make considerable difference in filling your order for Valves.

If you want genuine Valves, don't specify "JENKINS" Valves on your order.

Say "JENKINS BROS." and say it with emphasis. Then look at your Valves and see if they bear the well-known trade mark shown above.

The manufacturers are responsible for all valves bearing this trade mark and are prepared to assume the responsibility.

Ask your dealer for *genuine* "Jenkins Bros." Valves. If he can't supply you write us for name of nearest dealer who will. We'll be glad to send you our latest catalog at any time.

JENKINS BROS., Limited, Sole Manufacturers
103 St. Remi Street - - - MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.

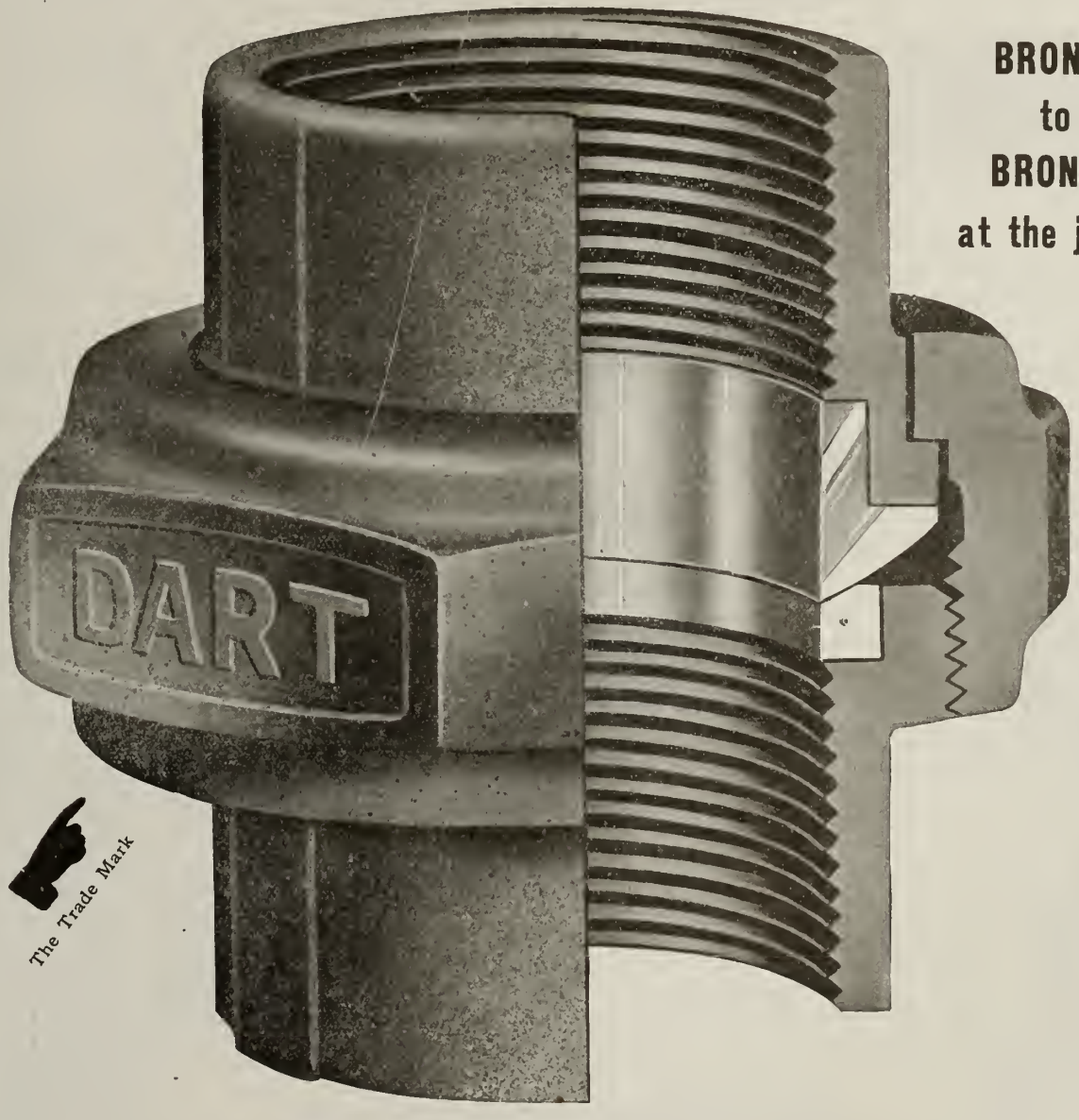
DART UNIONS are not affected by expansion, contraction or vibration and connect pipes in such a manner that the joints never leak.

Has Bronze on both faces of the joint, so that neither can rust or corrode.

Can be quickly connected time after time without bother or expense.

Give them a trial and be convinced that they save money, time and trouble. Your jobber supplies them.

Any union found defective bearing our mark will be replaced 2 for 1 or money refunded, as desired.



BRONZE to BRONZE at the joint.

DART UNION CO., Limited

93-97 Niagara Street, **TORONTO, ONT.**

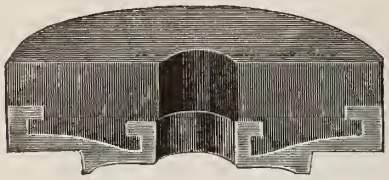
The advertiser would like to know where you saw his advertisement—tell him.

The ASBESTOS & RUBBER GOODS CO.

TORONTO, Ont.
141 King Street East,

MONTREAL, Que.
43 St. Francois Xavier Street,

L. R. & B. PUMP VALVES



Give better service than any other, and last longer

Brass Casing prevents ports from forcing through.

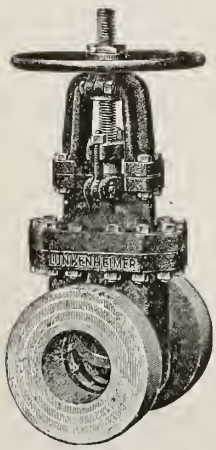
Only best quality of material is used, and as wear takes place the rubber can be replaced until brass casing is reached, thereby giving full use of all the rubber.

It only needs a trial to convince you.

We also carry a full stock of all other engineers' supplies.

Write us before placing your orders.

Iron Body, Brass Mounted. Stationary Stem.



Iron Body, Brass Mounted, Rising Stem.

LUNKENHEIMER "VICTOR" GATE VALVES

This line of Gate Valves is the largest and most complete made. It consists of Medium and Extra Heavy **Brass Valves;** Standard, Medium, Heavy and Extra Heavy **Iron Body Brass Mounted Valves; "Puddled" Semi-steel and Cast Steel Valves.** All of these patterns are made in two styles—with **Stationary Stem** or with **Outside Screw** and **Yoke,** and in all standard sizes.

The high grade bronze composition used contains a large percentage of copper and tin; the Iron is hard and close-grained, and has a tensile strength of 25,000 pounds per square inch; the "Puddled" Semi-steel, for superheated steam, has a tensile strength of 35,000 pounds, and the Cast Steel, for extreme conditions of strain and superheat, has a tensile strength of nearly 80,000 pounds per square inch.

Lunkenheimer "Victor" Gate Valves are practically indestructible, inasmuch as all parts subjected to wear can easily be renewed, without necessitating their removal from the connecting pipe, and this includes the seat and disc.

The valves are double seated and will therefore take pressure from either side. They are absolutely tight, easily operated, and the stuffing-boxes can be packed under pressure when the valves are wide open.

Specify and insist upon securing genuine **Lunkenheimer make.** Do not accept substitutes—they are never as good as the genuine.

"MOST supply houses sell them—yours CAN—if they DONT or WONT tell US."

Write for 1912 Catalogue.

THE LUNKENHEIMER COMPANY

Largest Manufacturers of high-grade Engineering Specialties in the World.

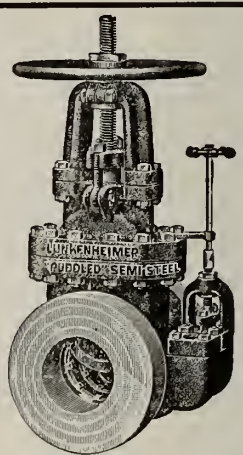
General Offices and Works: CINCINNATI, OHIO, U.S.A.

NEW YORK
64-68 Fulton Street

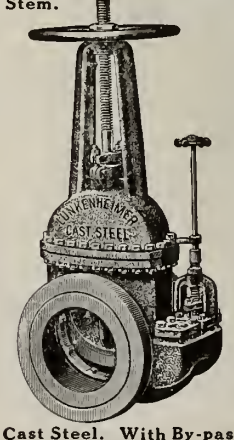
CHICAGO
186 North Dearborn Street

BOSTON
138 High Street

LONDON, S.E.
35 Great Dover Street



"Puddled" Semi-steel. With By-pass and Rising Stem.

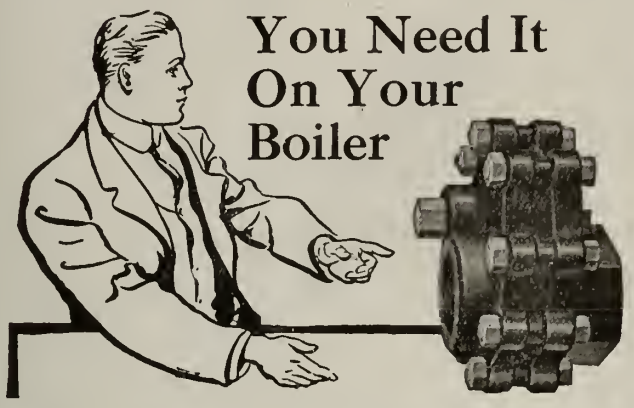


Cast Steel. With By-pass and Rising Stem.

BY MAKING GOOD

The "EVERLASTING" BLOW-OFF VALVE

has made a name for itself. It can live up to its reputation, and can save you time and worry. You have a good boiler, why not put the best accessories on it.



You Need It On Your Boiler

Here is Another

THE "FLEXIBLE" TUBE CLEANER

IT CUTS
SAVES HALF THE LABOR and
CLEANS THE TUBES

Engineering Specialties Company

1080 King Street West — TORONTO, ONTARIO

AGENTS:

H. L. PEILER & CO., 380 St. James Street, Montreal

THE A. R. WILLIAMS MACH. CO. OF ST. JOHN, N.B., LTD., St. John, N.B.

P. D. McLAREN, LIMITED, Calgary, Alta.

6" Flanged End Kerr Gate Valve

When next you order an Iron Body Gate Valve, specify

Kerr's New Pattern

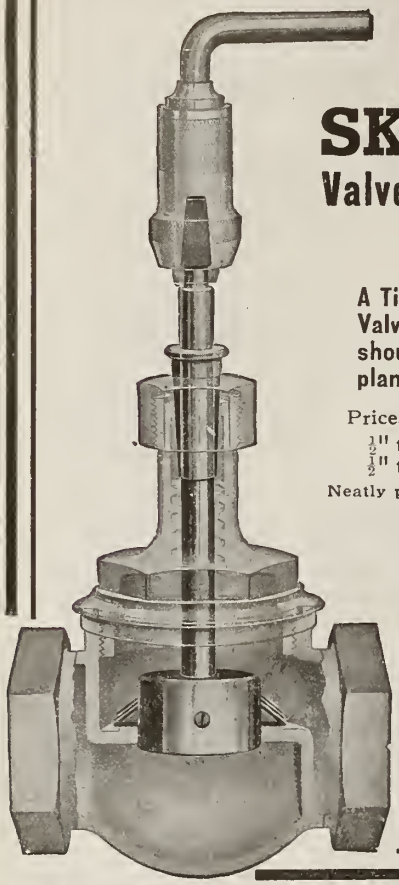
LIKE THIS ILLUSTRATION

We want you to see and try what we know to be the strongest and best made Valve on the market for Standard pressure. Every Valve tested 300 pounds Hydraulic Pressure.

THE KERR ENGINE CO., Limited

WALKERVILLE, ONTARIO.

The advertiser would like to know where you saw his advertisement—tell him.



The SKINNER Valve Re-seating Tool

A Time, Money and Valve Saver which should be in YOUR plant.

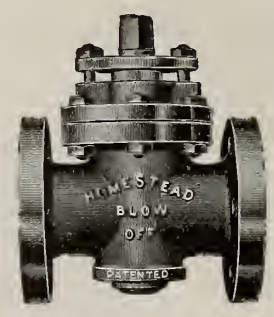
Prices f. o. b. Montreal
½" to 2" - $20.00
½" to 3" - $30.00
Neatly packed in wooden box.

H. L. Peiler & Co,
380 St. James St.
MONTREAL
69 Adelaide St. E.
TORONTO
McLeod Bldg.
MONCTON, N.B.

W. E. Skinner, Ltd.
618 Somerset Bldg.
WINNIPEG

HOMESTEAD STRAIGHTWAY VALVES

ALWAYS OUTLAST OTHER VALVES



For Pressure Up to 5000 lbs. per. Sq. In.

The reason is very evident.

Where the common Globe and Gate Valves have their vital parts—the seats—exposed to pressure and constant wear, every minute they are open, the seat of the Homestead Straightway is never exposed.

The plug is balanced and held in place by the pressure when open, and when closed it is locked in the seat hy our patent wedging cam, insuring freedom from friction in the seat while the plug is turning and making the Homestead the quickest acting, the simplest, the most easily operated and the most durable valve known.

Let us send full details. Write

Homestead Valve Mfg. Co.
PITTSBURG. PA.

These are the telling points about

Bakelite

Valve Discs

They will not leak under high temperature, excessive pressure or when used in acids or other special liquids. Neither cold water, dry or superheated steam has the least effect upon them. **BAKELITE** Discs are a gas-tight fit.

BAKELITE is a successful substitute for expensive metal. Its structure is fibrous, giving strength and hardness. It can be reground and refaced, always retaining a uniform surface. It cannot be injured, except by accident or friction. Remember Bakelite **PUMP VALVES** do uot warm with changes of temperature.

Order your valves fitted with Bakelite Valve Discs and stop that perpetual annoyance and expense caused hy leaking valves. Depend upon it, Bakelite Valve Discs will not leak.

WRITE FOR PRICES OR ASK YOUR DEALER.

PLASTICS, Limited, - Van Horne St., TORONTO

Sole Agents for Alberta, Saskatchewan and Manitoba.
Bakelite Valve Discs and Pump Valves.
GENERAL SUPPLY CO. of CANADA, LIMITED, Winnipeg.
Head Office, Ottawa. Branches: Winnipeg and Toronto.

The (Double R.-R.) Gasket

Made in Canada

In these Gaskets are combined all the strength and durability of Copper, with the heat resistance and "pack-ability" of asbestos.

They make tight joints, where nothing else will—where the best of other gaskets fail these make permanently tight joints.

All we ask of you is to write us for prices, then we know you will try them.

Remember, these gaskets are made right here in Canada by the

CANADIAN GASKET CO.

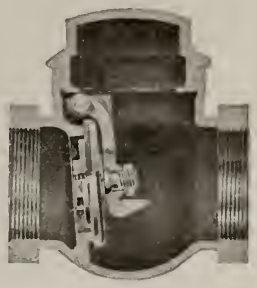
BRIDGEBURG, ONTARIO

Manufacturers of corrugated copper gaskets, any size shape or thickness. Boiler Gaskets of all kinds, including our Lead Man-Hole Gasket any size 50c. each.

(NO DUTY TO PAY)

The advertiser would like to know where you saw his advertisement—tell him.

Outside View of Standard Valve for 125 pounds working pressure.

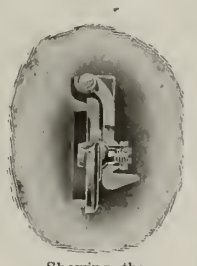


Inside View, showing Leather Disc for Hydraulic Service.

Nelson

Bronze Swing Checks

Simple.
None like it.
No *Joints.*
No *Plugs.*
Body cast in *one piece.*
Bearing for clapper *cast solid* in body.
Only *five parts* in steam valve, with bronze disc; (the leather disc and nut are added for hydraulic work).
The clapper bearings swing easily, almost *without any wear or friction.*
Free ball-and-socket movement in disc *compels perfect seat.*
Full 100 per cent. flow when open.
Works well in *any position,* vertical, angle or horizontal.
All parts renewable and interchangeable.
Well balanced proportions.
Strong.
Standard, for 125 pounds working pressure, *tested to 250 pounds.*
Extra Heavy, for 300 pounds working pressure, *tested to 800 pounds.*
Design, Metal, Workmanship, same high grade as in Nelson Gates and Globes.
You can't find a better.



Showing the Bronze Disc Mechanism

Nelson Valve Company

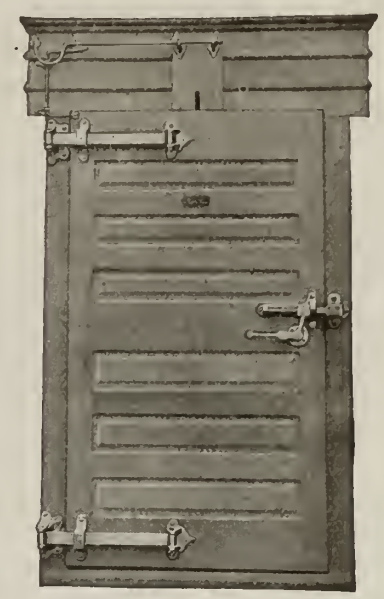
PHILADELPHIA

MONTREAL, 12-14 University St. | NEW YORK 30 Church St. | CHICAGO, 17 W. Kinzie St. | SAN FRANCISCO 22 Battery St.
PITTSBURGH 517 Liberty Ave. | MINNEAPOLIS 625 Andrus Bldg. | BUTTE 50 E. Broadway

We make nothing but valves, but we make all sizes, for any pressure, for every purpose. Gates, Globes, Angles, Checks and Blow-offs. High-grade valves exclusively. No competition stuff whatever.

If your dealer hasn't complete stock, write nearest Nelson office—WE WILL TAKE CARE OF YOU.

J. V. Jamison, President. T. B. South, Vice-President. J. V. Jamison, Jr., Treasurer.



This "Ad" is addressed to users of

Refrigerator Doors, Windows and Ice Chutes

in Canada

for Cold Storage, Meat, Fish, Dairy, Poultry, Fruit and Vegetable products.

We guarantee our Doors not to sag or stick in the frames.

Our Hardware weighs 60 lbs. to set.

We manufacture or sell nothing else.

Our entire time and forces are directed to this line.

We supply

Linde British Refrigeration Co.
Linde Canadian Refrigeration Co. of Canada.
Armour & Co., Chicago, Ill., U.S.
Swift & Co., Chicago, Ill., U.S.

with all they use. Our latest orders are to Swift & Co., for Toronto, Can., 30 Doors; Canadian Fish and Cold Storage Co., Prince Rupert, B.C., 110 Doors.

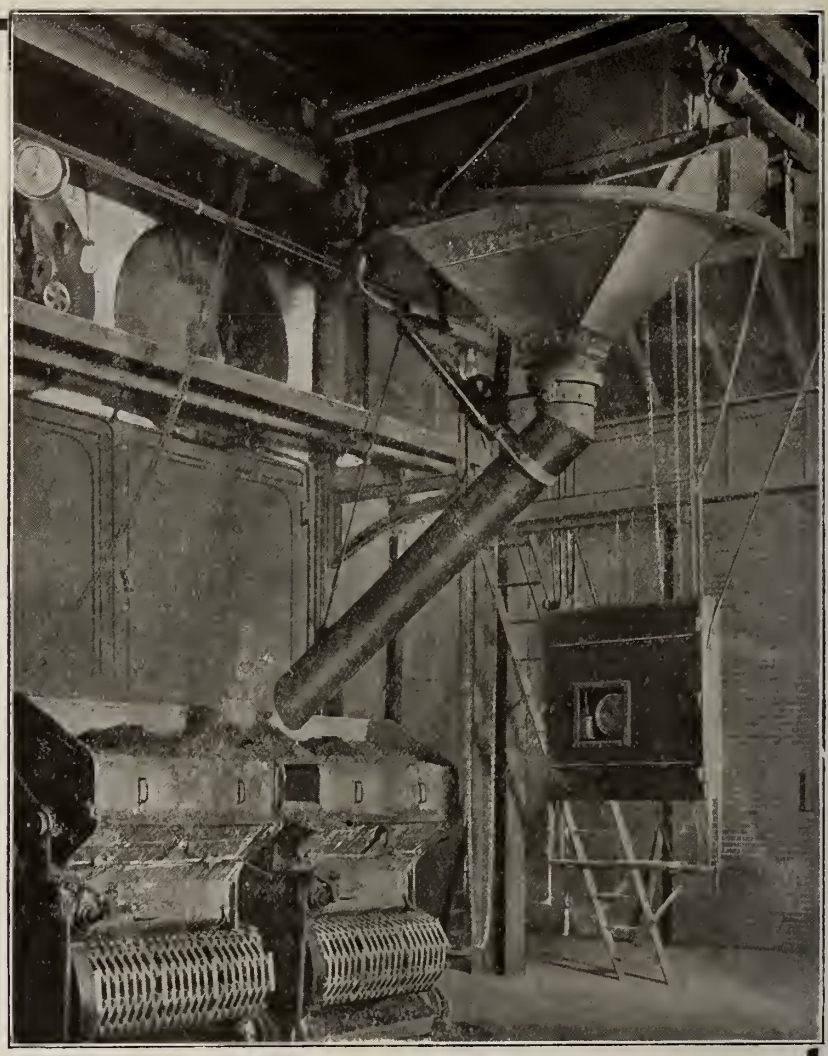
Send for Catalogue

Jones Cold Store Door Co.

HAGERSTOWN, MARYLAND, U.S.A.

Do You Know to a Pound How Much Coal Your Boilers Burn?

Don't You Want to Know?



FAIRBANKS' SUSPENSION COAL SCALE
Montreal Tramways & Power Co., Limited

Not knowing, to the pound, how much coal your boilers burn, how can you determine with any degree of accuracy the efficiency of your boilers? The true energy-producing quality of your coal? The cost of your power?

We show here a one ton Fairbanks' Suspension Coal Scale, with quick weighing dial, installed in the Power House of the Montreal Tramways & Power Co., Limited. With this scale they can check to a pound the amount of coal the boilers use.

The scale hopper is mounted on a trolley which runs on a track in front of the boilers and this trolley is operated by means of a motor controlled from the floor below. The scale hopper is filled from the overhead coal bunkers, the coal weighed, and the trolley is then run along the track until it is opposite the boiler you desire to feed. There the coal is dumped into the feed hoppers of the automatic stokers.

This scale should be in every up-to-date power house. It can be adapted to meet your requirements. Let us know what the conditions are in your power house. Write for further particulars.

The Canadian Fairbanks-Morse Co., Limited

FAIRBANKS' SCALES—FAIRBANKS' VALVES—FAIRBANKS-MORSE GAS ENGINES, SAFES, VAULTS, Etc.

Montreal St. John Ottawa Toronto Winnipeg Saskatoon Calgary Vancouver Victoria

Ventilating a Valuable Fact

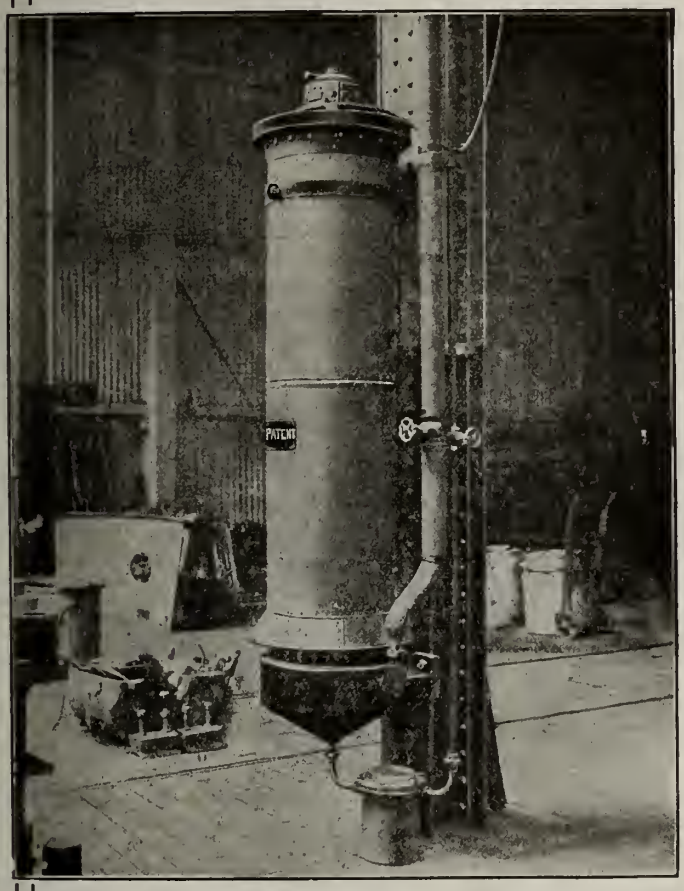
A Subject of Vital Importance to Your Business

It is a well established fact that a man working in a properly heated and ventilated shop can accomplish far more than the same man working in a poorly heated and ventilated shop. He can do more, and do it better, and stands a bigger chance of doing it day in and day out.

THE STANLOCK SYSTEM

of Heating and Ventilating

Inexpensive at the start and completely satisfactory in use. Adopted by many leading engineers and big manufacturers in this country and Europe.



The System

This system consists of units as shown below. They are made of steel tubes screwed into circular cast iron bases and through these tubes steam passes. Enclosing these tubes is a sheet metal cylindrical casting with a motor at the top. The air is forced downwards, thus keeping the floor warm. A special pipe can be fitted, passing through the roof or through the side wall, thus giving a supply of fresh air. Dampers are provided so that the inside air can be circulated or outside air can be taken in and heated. Can be installed in old or new buildings.

Its Advantages

1. No overhead air ducts are required.
2. No underground masonry ducts are required.
3. No obstruction to light due to overhead air ducts.
4. No heat losses due to radiation from air ducts.
5. Minimum of power absorbed.
6. Units hung on walls. No floor space needed.
7. Various units operated independently and can be turned on or off like radiators. Some supply fresh heated air and others merely circulate and heat.
8. A unit using 60 lb. steam pressure heats 3,600 sq. ft. of floor space.
9. The first cost of apparatus is very low.
10. Units may be added at any time in case of extensions, and in case of boiler shops, units may be removed entirely during the summer months, if desirable.

IT WILL PAY YOU TO ASK US FOR COMPLETE INFORMATION AND AN ESTIMATE ON YOUR REQUIREMENTS. DICTATE A LETTER TO-DAY

THE GARTH COMPANY

Sole Canadian Agents

26-32 Craig Street, Montreal

Thomas Elliptic Grate Bars

DESIGNED to produce a bar that would give long, hard use under adverse circumstances—everlasting.

TEST produced a bar that expelled ashes and slag clinker making matter in its molten state, but not dirt clinkers—self cleaning.

CONSTRUCTION Two oppositely curved surfaces joined together at intervals with connecting and spacing lugs. All parts scientifically arranged.

ADVANTAGES **Easy Firing—Increased Steam—Less Fuel Used.** Being circular has great strength and is adaptable to every kind of fuel and all kinds of draft spaces; having open spaces in the sides keeps the lower part cool by a lateral draft radiating the heat from the connecting lugs and prevents crystalizing, which gives long life. The top surface being oval, sheds the ashes automatically and the molten clinker making matter rolls off in its molten state in the form of a cinder, thus eliminating slag clinkers, which gives a clean fire at all times. The bottom surface being oval has great strength and holding power and with the draft spaces in the sides protecting it from the heat, gives it a long life. Has 20% more grate surface than flat top grates same area.

They Save You Money Because

THEY LAST LONGER **INCREASE BOILER POWER** **SAVE FUEL** **SAVE LABOR**

They are made of PIG IRON of special analysis—heat resisting, Their construction is practical and scientific—last longer. Their operation is the shedding of ashes and slag—self-cleaning. Their shedding ashes burns the fuel better and aids combustion. Their shedding slag eliminates the formation of slag clinker. Their self-cleaning effect reduces labor in cleaning fires. Their reduced consumption of fuel reduces labor of handling fuel. Their self-cleaning increases combustion through open draft spaces. Their increased combustion secures additional heat units. Their increased heat units give increased boiler power. Their increased boiler power increases plant efficiency. Increased plant efficiency reduces cost of output.

They will not

Shed dirt or sand, which melts into a sticky, gummy mass that spreads out over the surface of the bars like gum, and does not separate itself into particles and run like iron or slag—this is glass, and can only be expelled through the fire door with a hook.

Made with every style of Draft Openings
FOR EVERY FUEL

For **USE** in Locomotives, Steam Boats, Saw Mills. Planing Mills, Ice Plants, Water Works. Electric Light Plants, Cotton Mills, Fertilizer Plants. Mines and everywhere steam is made.

SIZES Elliptic Bars are 6 inches wide and any length.

Let us send you a list of more than 500 steam users in the States who are giving 2nd, 3rd, 4th, 5th, 6th, 7th and 8th repeat orders. Or send us a trial order for prompt shipment from Hamilton, and let the BARS demonstrate their value and worth.

The General Supply Co. of Canada, Ltd.

OTTAWA **TORONTO** **WINNIPEG**

Thomas Grate Bar Co., Birmingham, Ala., U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

WE Guarantee Results—Beware of Imitations

"THE Cyclone"

Shaking and Dumping Grate Bar

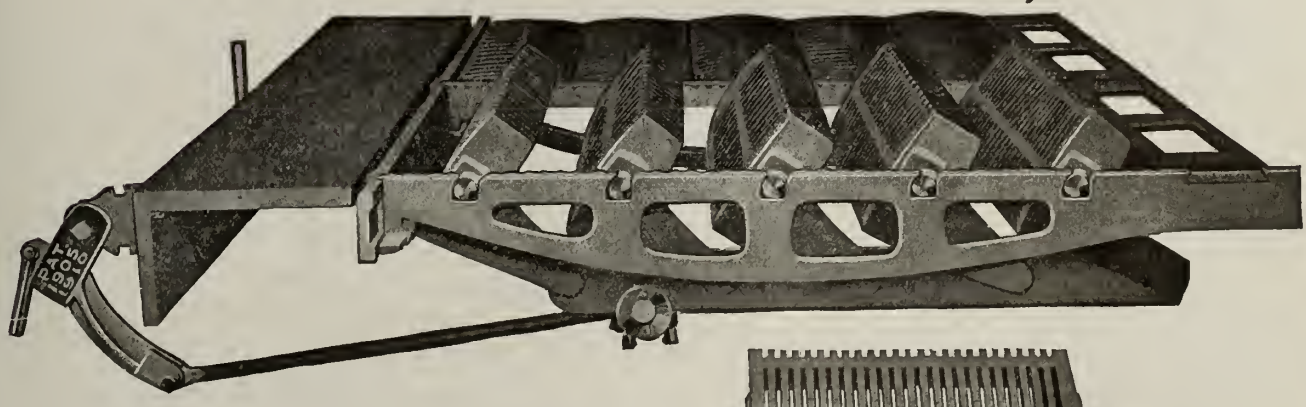
Will Reduce Your Fuel Bills 25%

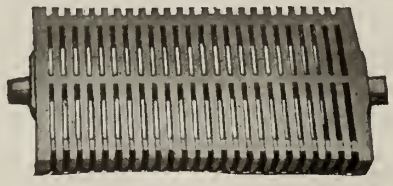
The Grate Bar that will generate more steam for fuel consumed than any other Grate in the world. And it is the only grate from which you can get the maximum results when burning the cheapest kinds of fuel (Soft and Hard Coal Screenings, Hard or Run-of-Mine Coal.) The reason WHY? Because

THE "CYCLONE" GRATE allows 68 per cent. of air space and 90 per cent. underdraught. And by its improved shaking mechanism, the shaking is rendered very much more vigorous, and no ashes remain on the centre of the grates—the place where in other makes, they usually are found to cling. This feature adds largely to the life of the grate.

The "Cyclone" locks level, cannot get out of adjustment, and will never warp. We can show scores of letters from leading business houses appreciative of the virtues and economy of the "Cyclone."

Why continue using an inferior and less economical grate when the "Cyclone" is at your service?





Let us send you full particulars regarding this imitated grate bar.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST - - - - TORONTO, CANADA

AGENTS

ST. JOHN, N. B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.

GRIT

The special fitness and value of Magnolia Metal for bearings which are subject to **grit and dust** has always been most noticeable and is frequently commented upon by Engineers as shown in the following letters:

THE CLEVELAND TRINIDAD PAVING CO.
Cleveland, O.

Branch Johnson City, Tenn., Dec. 15th, 1911.

Gentlemen:—We have used "Magnolia" exclusively the past three years on the asphalt plants of this Company that have been in my charge in Oklahoma City, Muskogee, MacAlester, Emporia, Kansas and Johnson City, Tenn.

Have used it on Westinghouse, High Speed and other Engines, also on bearings that were subjected to much **sand and grit**, and find it the nearest to "perfect" of any antifriction Metal.

Very truly,
CHAS. R. COOPER, Plant Supt.,
The Cleveland Trinidad Paving Co.

HOWARD TRUMBO, CONTRACTOR,

Key West, Fla., Nov. 23rd, 1910.

Dear Sirs:—I have used MAGNOLIA METAL for the past 15 years and found it satisfactory in every respect. Used it in thrust bearing, crank and cross-head bearing of the Steamer Bolivar; for the Union Bridge Co., and was on steamer for 18 months; when I left every bearing was O.K., and used it on several other steamers and tugs, also stationary work, and it gave perfect satisfaction. The last time I used Magnolia Metal was on the Hydraulic dredge Minikee, on the pump bearing, especially the bearing next to the pump where **sand and grit** from the pump gets in, a stream of water is pumped next to bearing to keep **sand and grit** out or away from said bearing, and after 8 months' work, this bearing was found in first-class condition, and started on another job last March, and it was still running when I left to take my present position with the Government, Quart. Master Dept., Key West, West Barracks, Fla.

Yours truly,
ALBERT DI NEGRO,
Chief Engineer Ocean Steamer.

GOGEBIC HOTEL AND COTTAGES,

Gogebic, Mich., Dec. 12th, 1910.

Gentlemen:—Having used MAGNOLIA METAL in my business as Marine Engineer for a number of years, I must say it is the best composite metal that I know of for Engine bearings, and has always proved of great value in keeping cool when propeller and crank shafts are run at high speeds, and also when bilge water has washed **grit and ashes** into main bearings during a storm. We use no other metal for bearings that have to be relined.

Yours very truly,
J. E. MARSHALL, Engineer.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

SPECIAL OFFER

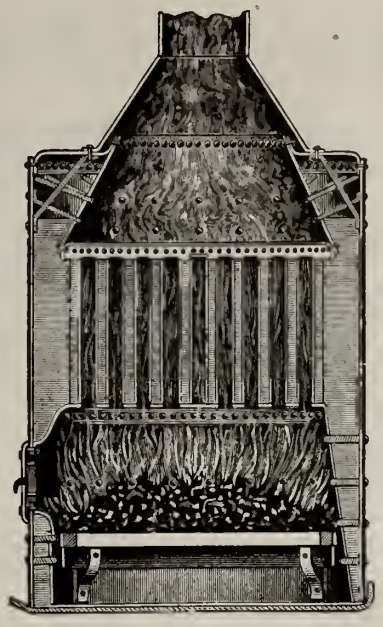
PRACTICAL ENGINEER POCKET BOOK, 680 pages, over 2000 subjects. Price 40c. postpaid. We do not aim to make a profit on these books. We buy them in large quantities as an advertising medium and give engineers benefit of low price. They are highly spoken of by Engineers.

Address Montreal Office

Magnolia Metal Co.

Office and Factory:

225 St. Ambroise Street - Montreal



Marine Boilers

We build various types: Scotch, Clyde, Fitzgibbon, Vertical, Mosher.

Land Boilers

Horizontal, Tubular, Vertical, Locomotive Type, Water Tube, "Heine."

GENERAL PLATE WORK

THE BEST MATERIAL, MANIPULATED BY EXPERIENCED WORKMEN, ENSURES A FIRST CLASS BOILER.

We Employ Both. ***Consult Us.***

POLSON IRON WORKS, LIMITED

STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

TORONTO **CANADA**

REPRESENTATIVES IN CANADA FOR

The B. F. Sturtevant Co., Hyde Park, Mass., U.S.A., Fans, Blowers, Heating and Ventilating

The John I. Thornycroft Co., London, England, Marine Motors

BENNIS CHAIN GRATE STOKER

More air space is provided to each square foot of grate area than with other makes, and without additional widening of the **actual** air spaces.

The continuous surface of the grate ensures economy in the length of the grate.

By means of the continuous drive, smoothness of running is assured.

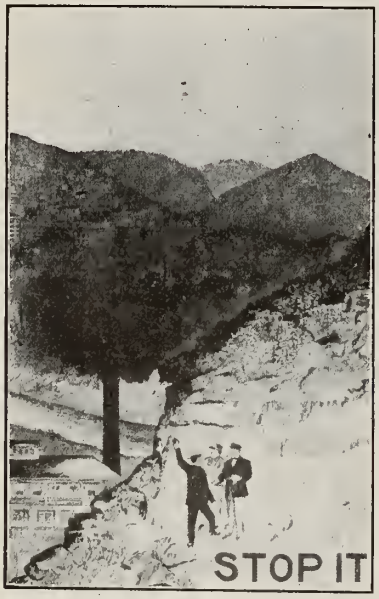
The speed of the stoker can be adjusted to a nicety, as there are six variations.

The stoker can be easily hand-fired in case of emergency.

Fine slack fuels can be satisfactorily burnt.

Write for "Boiler House Economy," Pamphlets and Full Particulars to

GEO. H. TOD 213 Manning Chambers Queen Street West **TORONTO**

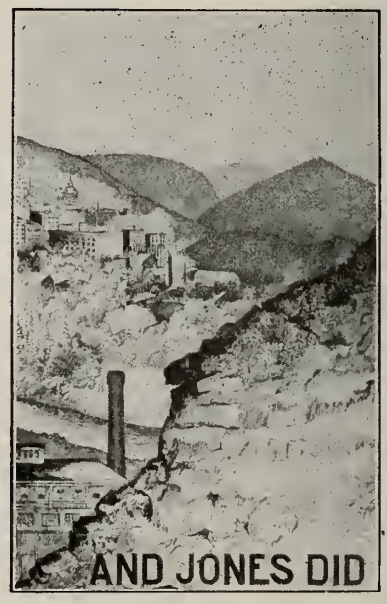


JONES UNDERFEED STOKERS

will "STOP" the smoke from your chimney and at the same time save you 15 to 20 per cent. in fuel bills over "good" hand firing!

We guarantee our improved equipment as installed to-day and will demonstrate a definite saving to any power plant owner in Canada!

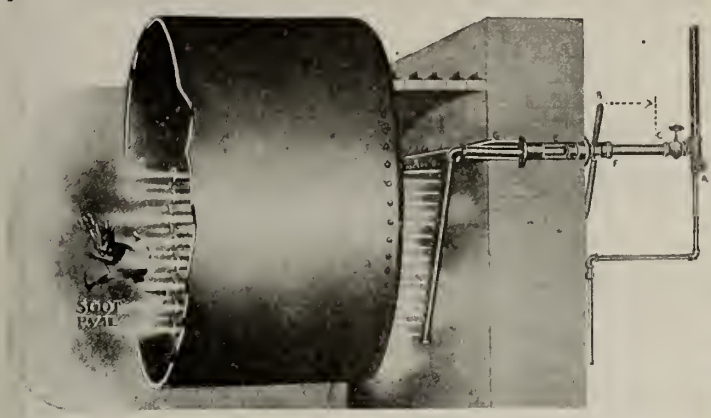
If we do not save the **coal** it will **cost you nothing!**



JONES UNDERFEED STOKER CO., Limited

NATIONAL TRUST BUILDING
TORONTO

MORE STEAM



The Vulcan Cleaning a Return Tubular Boiler

LESS COAL

KEEP THE SOOT OUT OF
THE BOILERS WITH THE

VULCAN SOOT CLEANER

You'll get more steam and you'll save 5 to 10% on your coal bill.

The difference between a clean heating surface in your boiler and a dirty one, is often the difference between dividend and deficit. It is the daiiy operating cost of a boiler that counts. If the boiler tubes are coated with soot you face a drop in capacity and a **big loss in efficiency.**

The profit lost through a dirty boiler would pay for a Vulcan Soot Cleaner many times over. The Vulcan will produce a saving for you the same as it does for others. It is the **modern** way of handling the soot problem.

Soot defies removal by hand blowing. The Vulcan scours the tubes as clean as gun barrels—removes **all** soot in a few minutes—no shut-downs—no time waste—no dirt—no trouble—no air leakage—nothing but complete satisfaction and results.

We send the cleaner on 30 days' free trial—return it if you don't like it. We won't get "sore" nor try to force the cleaner on you. **IT'S UP TO YOU.**

Return the coupon and get our trial proposition and a free copy of "Economical Steam Production," a complete and pointed discussion on soot and how to get rid of it.

Cleaning Water Tube Boilers is also OUR SPECIALTY

Vulcan Tube Cleaning Systems
LIMITED

42 Craig St. West, MONTREAL.

---SIGN, TEAR OUT AND MAIL---

Power House, June 12. *Date*.....

Vulcan Tube Cleaning Systems, Limited,
42 Craig St. West, Montreal.

Please send me without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.
(It is important that following information be given in full.)

Water Tube Boilers. Number.....Type.....Pressure.....
Horsepower.....No. Tubes High (except on Stirling boiler .....
Any Superheaters.....Width of alley space at side.....
Tubular Boilers. Number.....Horizontal or vertical.....
Name.....
Address.....

THAT DEVICE

ENSURES COMPLETE COMBUSTION AND INCREASED BOILER RATING

"The Typhoon" Turbine Blower

SAVES MONEY

It permits the use of the cheapest grades of fuel. Keeps the grate free from clinkers.

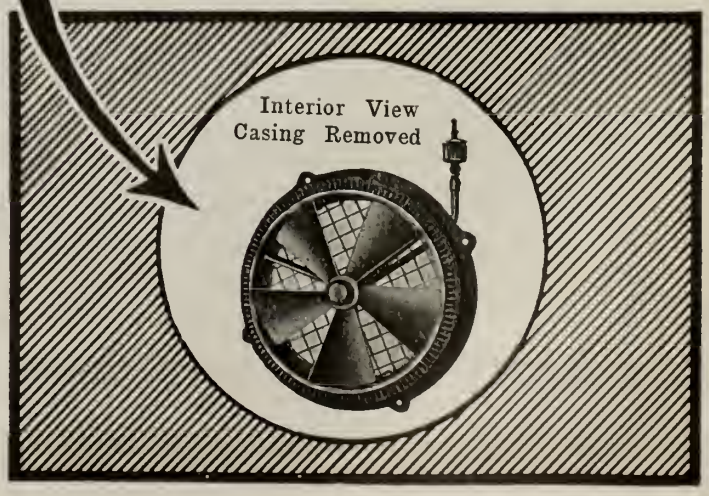
Produces a Powerful Forced Draft which mixes thoroughly with the quantity of dry steam used in driving the machine. This forced draft passes under the grate and the most powerful combustion ever obtained by any mechanical or natural draft system.

Easily attached and is inexpensive. Will pay for itself in a very short time with the money it saves.

Let us send you full particulars and testimonials at once.

The Hare Engineering Co., Limited

14-16 King Street East, TORONTO



The Murphy Automatic Smokeless Furnace

Commercially on the market 30 years. It is not an experiment.

See advertisement in the Power House, page 14, March, 1912.

BELGO CANADIAN PULP & PAPER COMPANY, Shawinigan Falls, P.Q.
has had two winters' experience with MURPHY FURNACES and they write:

Dec. 4th, 1911.

"Dear Sirs,

We have your letter of Nov. 28th enquiring as to conditions with us in which we presume you make special allusion to the Murphy Furnaces installed, and which we are pleased to state are working quite satisfactory. We are just now getting into the cold season, and an opportunity to test the Murphy Furnaces under overload conditions will be offered for the next three months, but judging by the way these furnaces have behaved so far, no trouble is anticipated for the period before us."

And under date March 16, 1912:

"Your letter of March 14th.

We have had, as you know, a very severe winter this year, and regarding your furnaces we are pleased to say that in spite of the low temperatures where the steam demand was excessively heavy, we have never lost a minute on account of steam, as the furnaces have stood up and done all that could be expected.

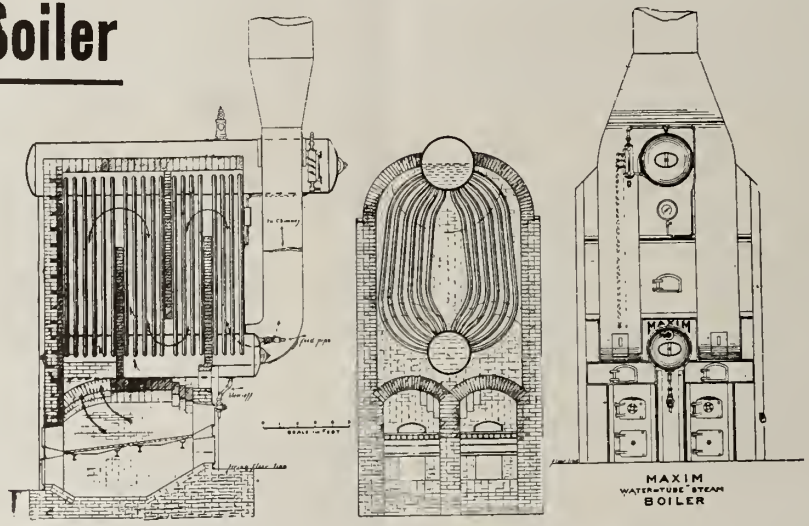
Yours truly,
THE BELGO CANADIAN PULP & PAPER CO."

Third order, May 1912—1 Furnace, 375 H. P.

Write for Catalogue and Information to

MURPHY IRON WORKS, DETROIT, MICH. BUFFALO, N. Y.

The Maxim Boiler



Did you ever operate a steam boiler—hard — for all it was worth? If for any considerable length of time, the tube ends leaked —unless with bent tubes. This Maxim Boiler will run at 100 per cent. overload, and the tubes will not leak. They never work loose. You know how straight tubes get leaky and have to be expanded from time to time to keep them tight until the ends are cut through with the expander and the tubes must be replaced.

Mr. Allan Stirling invented the Stirling Boiler, and after ten years' experience with the Stirling put the Maxim Boiler on the market—the most economical boiler made.

The Maxim Boiler could not be more simple. It consists of two drums and connecting tubes. You can see for yourself just what the boiler is.

An inspection of this boiler is not an all day job. Two man holes give complete access to the interior, and half a dozen brick work doors allow entrance at all parts of the exterior. You open the boiler and thoroughly inspect it without anything interfering with you. The firemen call it an easy job and the engineers find it a satisfactory job. It is done quickly and thoroughly without trouble.

The Keystone Watch Case Company, of Philadelphia, have tested their Maxim Boilers thoroughly, getting over twelve pounds of water per pound of combustible with flue gases below 400 degrees Fahr., and steam at 135 pounds pressure.

An ordinary boiler tube in being heated from cold water temperature to the temperature of the steam will increase in length about three-eighths of an inch. If the tube is straight and held rigidly at both ends, this expansion will either bend the tube or loosen the tube ends. If the tube is already bent the bend will increase, just as an already bent stick will bend more if leaned on.

Maxim Tubes never leak at the ends. They bend to take up differences of expansion and contraction. No strain is thrown on the expanded joints. Maxim tubes never work loose.

Ogilvy Engineering Company, Bank of Ottawa Building, **Montreal**

You Know That This Costs Fuel, Time and Labor

¶ It does not require much scale in a boiler to **waste** 666 2-3 lbs. of every ton of coal consumed. With coal at $3.00 a ton, this means a loss of $1.00 on every ton used.

¶ Why not stop this enormous **waste?**

J-M Boiler Preservative works under the scale in a boiler, loosening and breaking it up. It can then be easily blown off or washed off.

J-M BOILER PRESERVATIVE

Positively Removes Scale

After the scale is removed the J-M Preservative forms a thin, heat-conducting film on the boiler surfaces that prevents scale-forming elements from adhering to the plates and tubes. J-M Preservative also stops minor leaks and prevents corrosion.

J-M Preservative is made from a vegetable (sugar beet) base so cannot injure boilers, packing or the products of a plant.

It works successfully in any locality at any season of the year.

J-M Boiler Preservative does more and costs less than any other known scale-remover or preventive.

Write nearest Branch for Booklet and Trial Order Blank.

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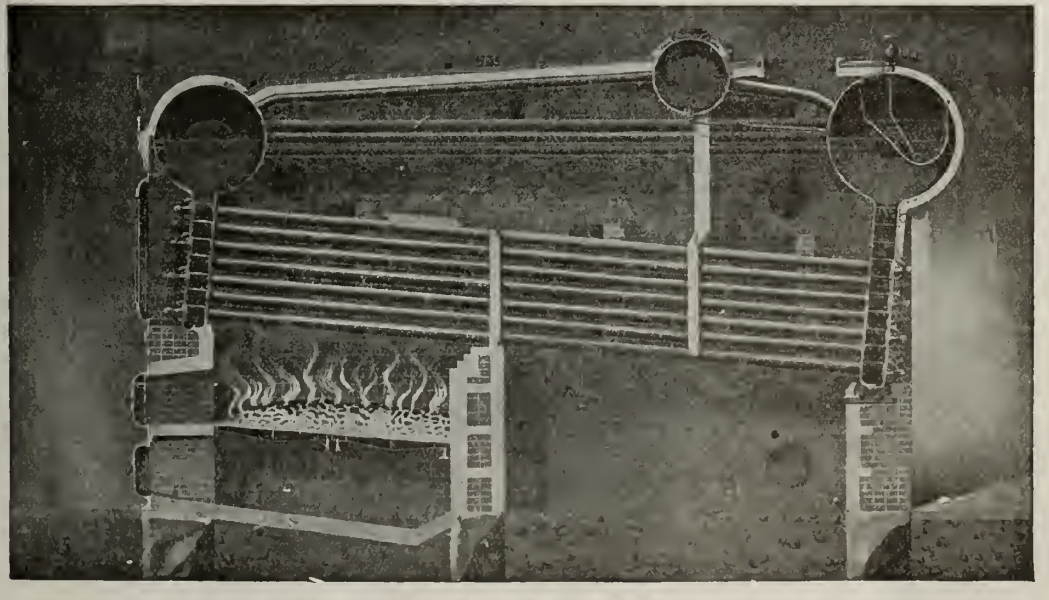

Save Coal

Superheat Steam

Purify Feed Water

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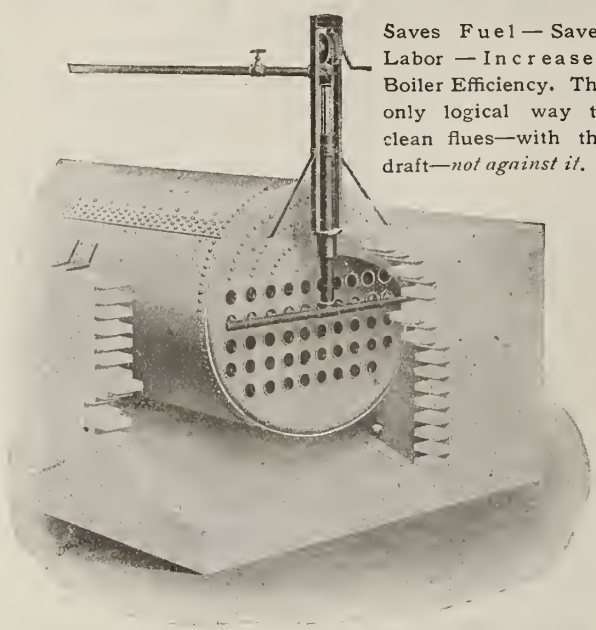

Saves Fuel — Saves Labor — Increases Boiler Efficiency. The only logical way to clean flues—with the draft—*not against it.*

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The Luitwieler Double Acting
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Non-Pulsating **No Vibration**

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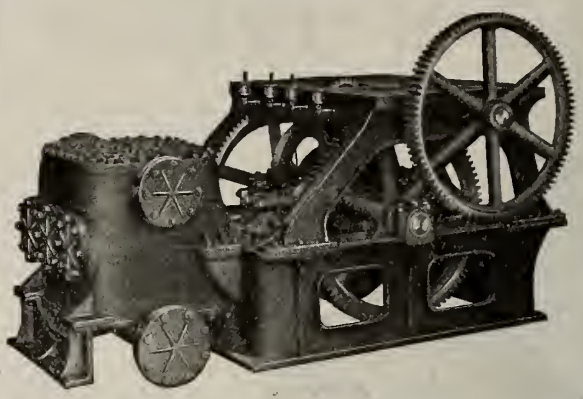

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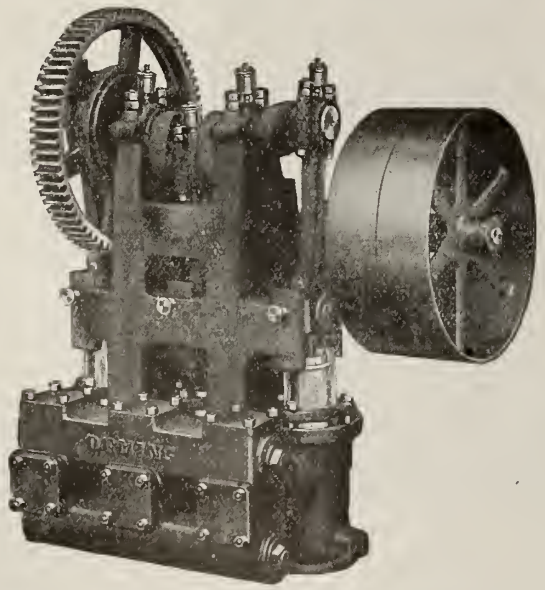
DEMING POWER PUMPS
NECESSARY IN POWER PLANTS



Belt Driven Deming Triplex Power Pump. For boiler feeding, tank service, general water supply, etc. Can be direct-connected to motor.

Not only in the "long run" have Deming Pumps demonstrated their money-saving qualities—but right from the start they have "delivered the goods," and in factories where "Scientific Management" is practiced, there you will find Deming Power Pumps

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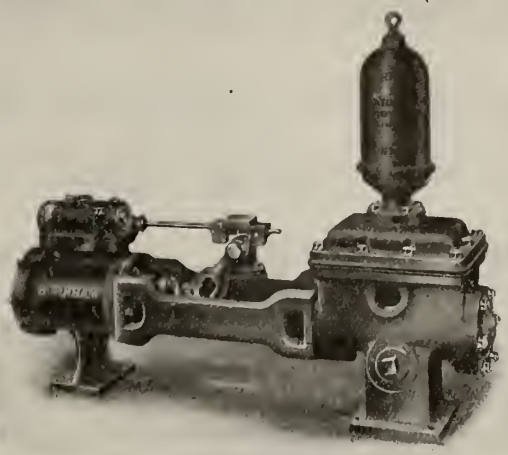
Of the thousands of steam pumps installed every year, a large percentage of them bear the name of "Burnham," the **Steam Pump** endorsed by leading Architects, Consulting Engineers and Heating Contractors as the best, simplest and most economical pump on the market.

If you want a pump for handling hot water, use the "Burnham."



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Thousands of Burnham pumps are in operation in connection with **Vacuum Heating Systems**; they are specially adapted for this service. Standard Burnham Boiler Feed Pumps and Burnham Vacuum Pumps are kept in stock and can be shipped promptly.

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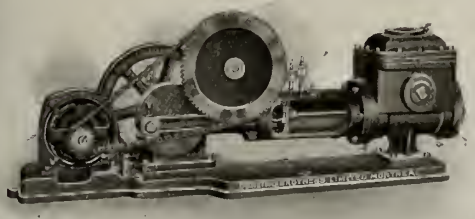

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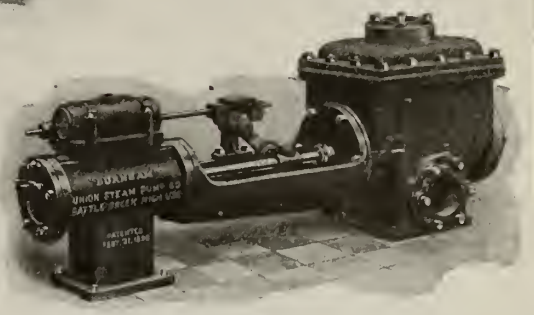

Burnham Vacuum Pump.

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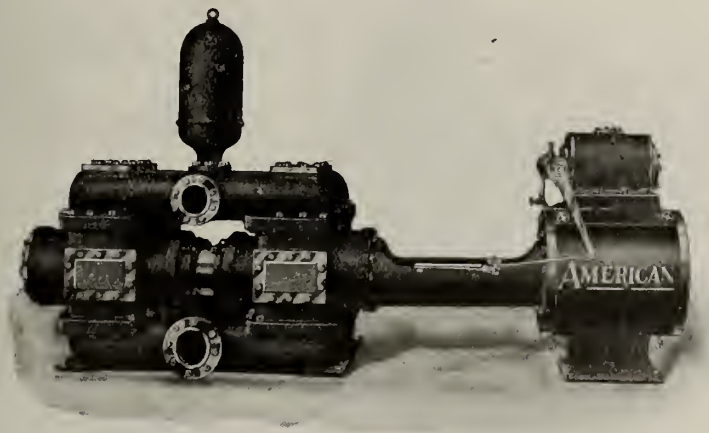

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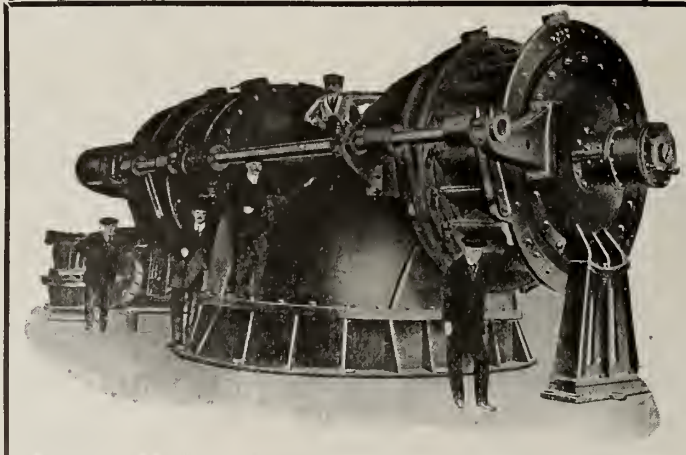

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We also have a **Large Horizontal Boring Mill,** and a quantity of **Small D.C. Motors**—all in good condition.

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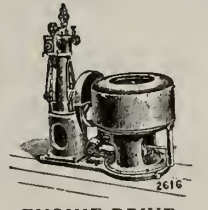

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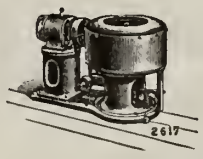

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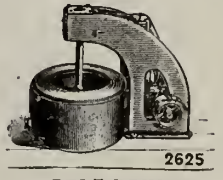

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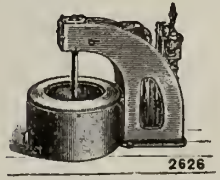

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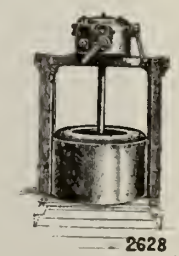

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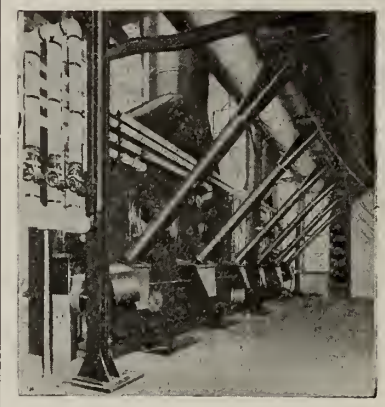

This illustration shows a Jeffrey Equipment delivering the coal from bunkers to stokers. The operation of handling the coal and ashes at this plant is entirely mechanical. The drudgery of human labor is eliminated.

The coal is dumped from railroad cars to track hopper, thence to crusher, the product falling directly into conveyer and is elevated to bunkers, where it is automatically discharged by means of Trippers.

Ashes are delivered to ash hopper by same conveyer, from which a spiral conveyer carries them to railroad cars.

Our Catalogue No. 32 A illustrates and describes over fifty coal and ashes handling installations. Request a copy to-day.

JEFFREY MFG. COMPANY

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"SIMS" TUBULAR FEED WATER HEATERS

Are Fuel and Boiler Savers.

Fuel is saved by utilizing the heat units in the exhaust steam to raise the temperature of the Feed Water, at the rate of One per cent. of fuel to every Eleven degrees increase in temperature. The life of the boiler is extended and repairs reduced by obviating strains from expansion and contraction, bound to occur when feeding cold water. A corresponding increase in horse power developed is an additional advantage.

"SIMS" Feed Water Heaters are made in all sizes; to and including 700 H.P., with cast iron shells, larger sizes with steel shells. The heating surface is provided in seamless cold drawn brass tubes, rolled into a fixed head at one end, and a floating head at the other, thus providing against strain due to contraction and expansion.

The tubes are so grouped as to insure positive circulation in several passes through the heater from inlet to out.

Full particulars and prices on application.

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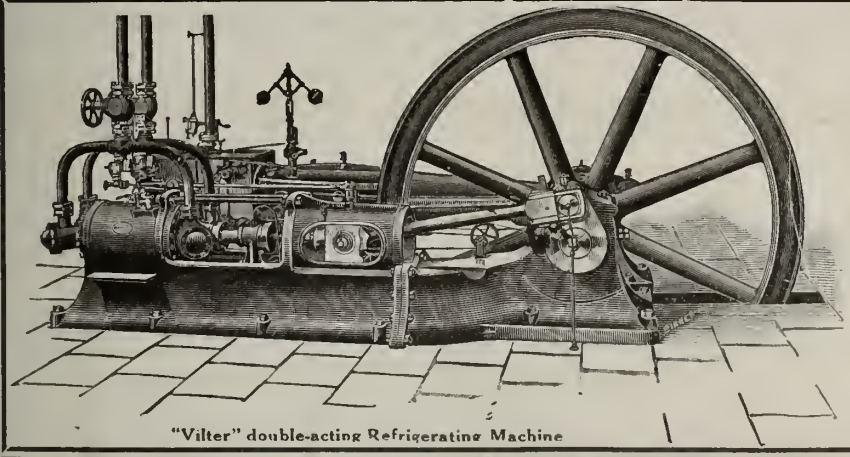

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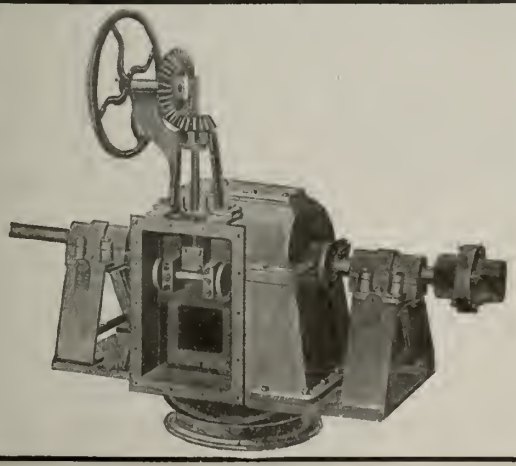

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Mounted on vertical or horizontal shafts. Gate consists of single casting, and is trouble proof. Adapted for all heads. Highest efficiency guaranteed.

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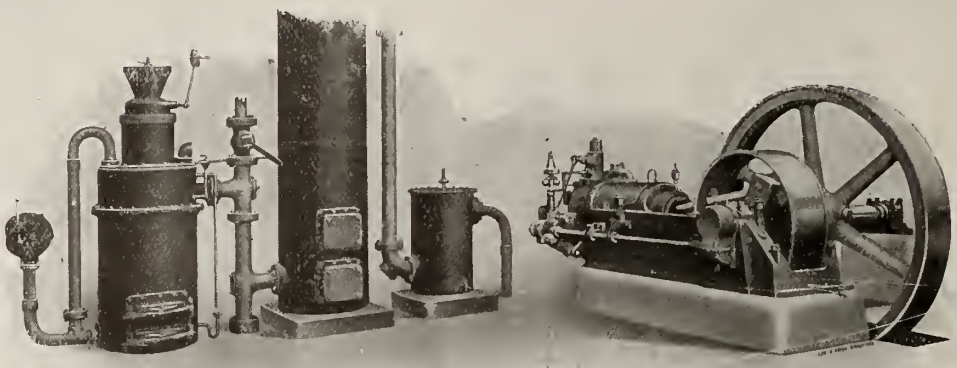

Sole Makers of the **"Robson"** Engine for working on Towns and Suction Gas.

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Suction Gas Producer Plants for working on Anthracite Coal, Coke or Charcoal.

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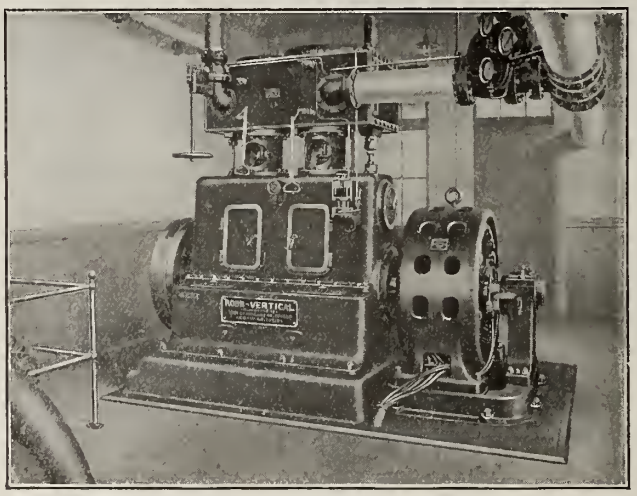

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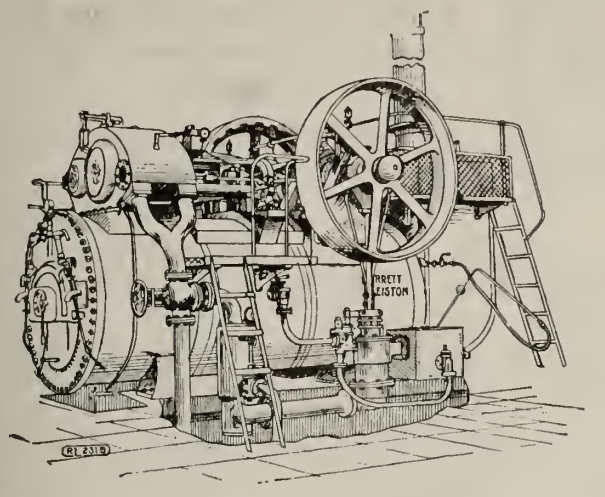
1.19 lbs. of COAL per B.H.P. Hr.



A Garrett Patent Superheated Semi-Stationary Engine has no pipe lines nor cylinder condensation losses. Note the remarkable results of this independent seven-hour test made on a stock machine.

Superheat	536.5 ° F.
I. H. P.	58.25
B.H.P.	55.6
Mech. Eff.	95.5%
Water evap. per lb. of coal	8.91 lbs.
Coal (per B.H.P. Hr.)	1.19 "
Water " "	10.66

Cut this Coupon out ***NOW.*** It will bring our most interesting booklet on the most efficient engine made. Used for every purpose.

Send me circulars re your Semi-Stationary Engine.

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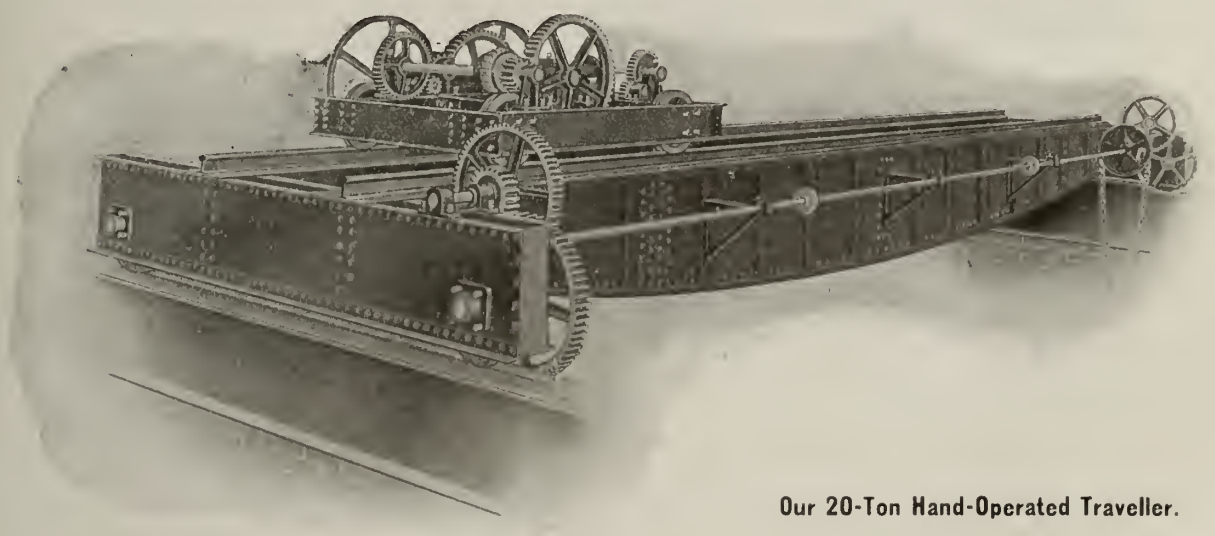
ALL TYPES **CRANES** **ALL SIZES**



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We design and manufacture all kinds of lifting and hauling appliances. Our experience and advice will be found worth having; let us know the nature of your business and we shall be pleased to advise the best equipment for your purpose.

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Over 1000 Terrys now in use on land and sea.

TERRY

It is standard practice to drive auxiliaries with Terry Turbines.

Three Typical Terry Turbine Power Plant Sets

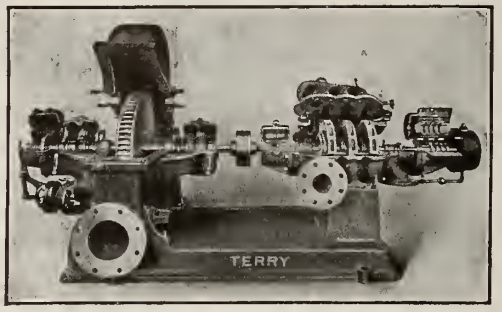

FIG. 1.

Driving Boiler Feed Pumps

TERRY TURBINES to-day drive boiler feed pumps (Fig. 1) supplying boilers totaling nearly a million boiler h. p. For this service Terry Turbines are built in capacities from 100 to 1,000 gallons per minute up to 300 lbs. pressure. Twelve of the 28 Terrys at the New York Edison Co. are used for boiler feed work.

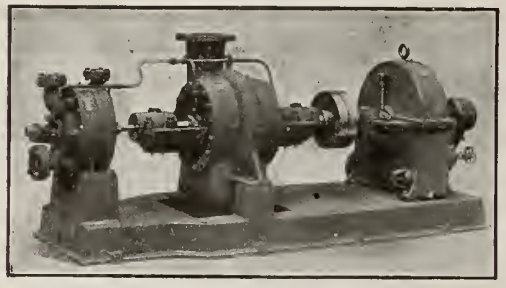

FIG. 2.

Condenser and Hot Well Service

TERRY TURBINES are driving centrifugal pumps used in over 55 different kinds of work. Condenser and hot well pumps are widely driven by Terry Turbines. A combined set for this service is shown in Fig. 2.

Reliability, absence of repairs, and exhaust free from oil are a few of the many Terry Turbine assets.

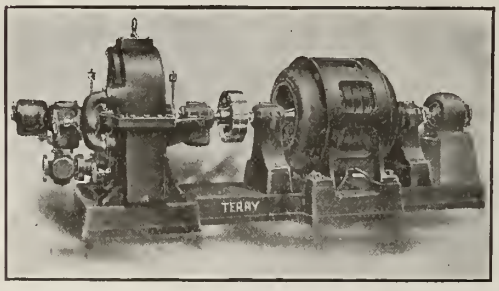

FIG. 3.

Driving Generators

TERRY TURBINE generators are built in sizes from 5 to 300 K.W., and designed at low speeds for either alternating current or direct current. The turbine and generator are mounted on same base, forming a compact, efficient and smooth running unit.

Write us your requirements. We have a bulletin for each service.

Send for bulletins and booklet "Terry Service."

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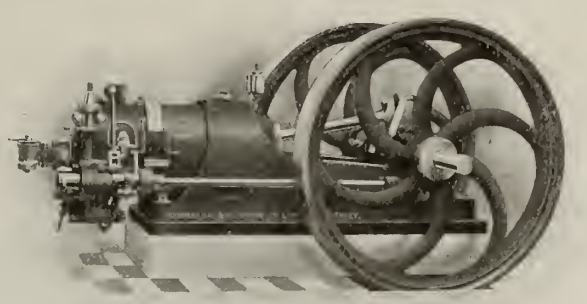

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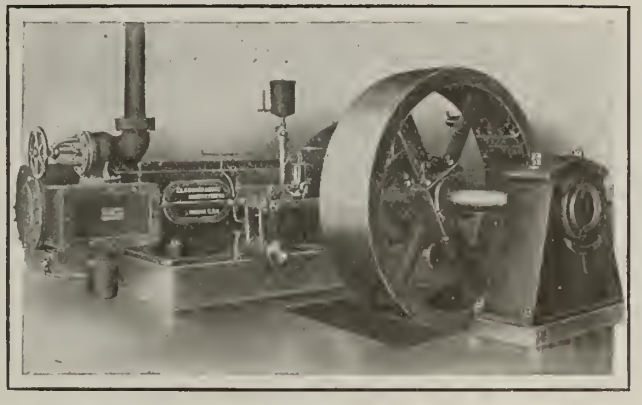

Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY

E. LEONARD & SONS, LONDON, ONTARIO

MANUFACTURERS OF

High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants.

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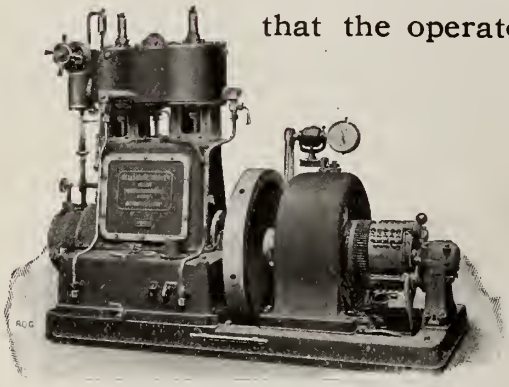
The advertiser would like to know where you saw his advertisement—tell him.

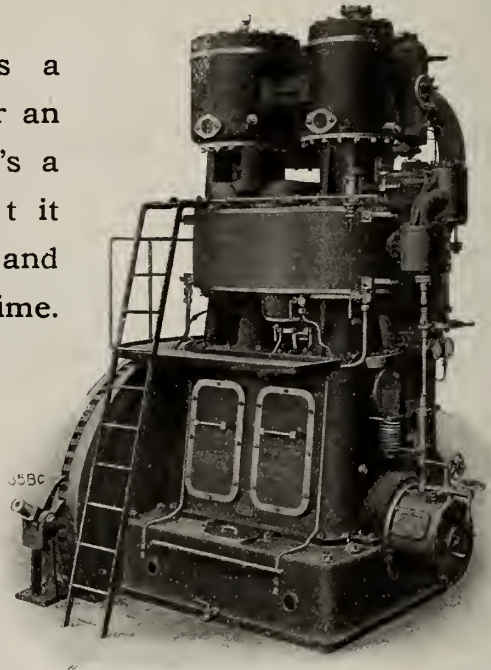
Do you know a station-ary engineer who has no engine trouble?

If so, he has a Belliss-Morcom Unit!

It does'nt matter whether it's a **Turbine**, a **High Speed Engine** or an **Air Compressor**; as long as it's a Belliss Machine it means that it requires a minimum of attention and that the operator has an easy time.



Belliss & Morcom High Speed Engine with dynamo direct connected.



Belliss & Morcom Steam Driven Air Compressor.

These are the points in which Belliss-Morcom Units surpass all others:

Perfect Material and Manufacture
Perfect Lubrication
Minimum Steam Consumption
Maximum Efficiency

SEND FOR PAMPHLETS

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LIMITED

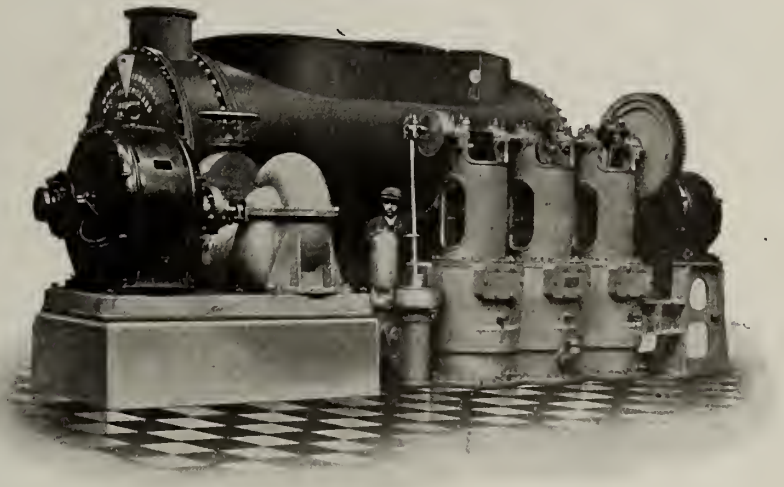
QUEEN'S ENGINEERING WORKS, BEDFORD, England

"CONQUEROR" Condensing Machinery

SURFACE, LOW LEVEL JET and BAROMETRIC JET TYPES

HIGH EFFICIENCY

Small Quantity of Circulating Water



66 thousand lbs. of Steam per hour 28 inch Vacuum. Centrifugal Circulating Pump driven direct by Motor, a separate Motor driving through gearing an "Allen-Edwards" Three-Throw Air Pump and Condensed Water Lifting Pump. 3

HIGH VACUUM

Low Power Required for Driving Pumps

Canadian Representatives

CHAPMAN & WALKER, LTD., 69 Victoria Street, Toronto

Resident Engineer for Canada: A. LEO MIEVILLE, A.M. Can. Soc. C.E.

HEAVY DUTY GOLDIE CORLISS STEAM ENGINES

Nothing but the best quality of material is used in the construction of these Engines, this coupled with the fact that the most skilled Mechanics obtainable are employed, explains why they are to be found in the most modern and best equipped Power Plants in Canada.

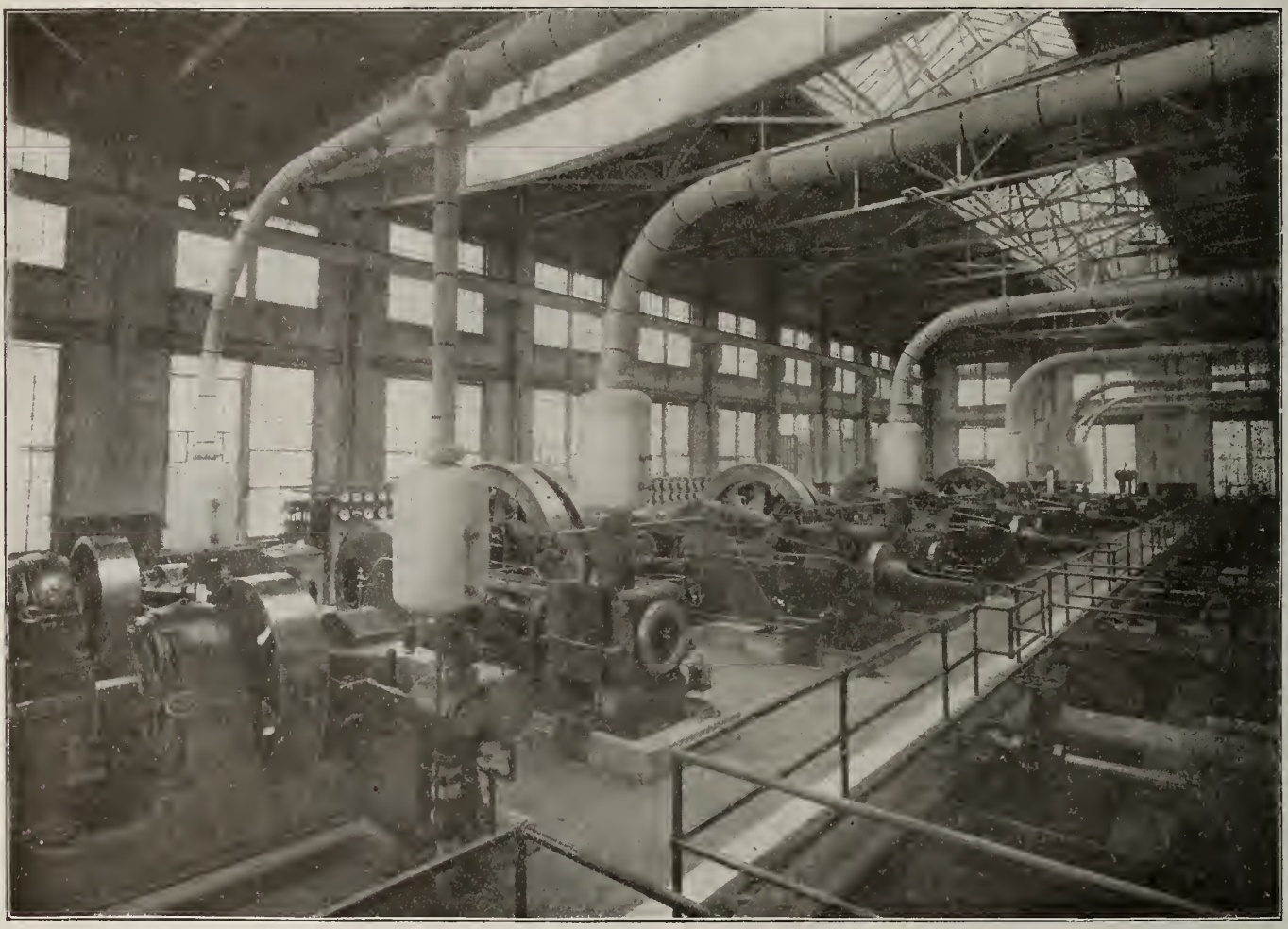


Illustration shows the magnificent new Power House of the Grand Trunk Pacific Shops at Transcona, Man., in which we have recently installed five Heavy Duty Goldie Corliss Steam Engines and two Ideal High Speed Steam Engines.

ASK FOR A COPY OF OUR NEW CORLISS CATALOGUE.

The Goldie & McCulloch Co., Limited

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Central Power House Equipment, N.T.R. Shops, Transcona

By J. H. Williams*

The growing appreciation of the paramount importance of having a thoroughly efficient and reliable power plant equipment form an integral part of every type and extent of manufacturing effort is amply demonstrated in the subject matter of this article. It is here shown that requirements have been wisely and carefully forecasted, and as a result, perusal of the details forms an attractive and educative exercise for every class of our readers.

THE large new shops of the National Transcontinental Railway at Transcona, near Winnipeg, are now, as far as concerns the locomotive department, ready for operation; although it will be some months yet before the car section is completed. This plant will eventually give employment to 3,000 or 4,000 men, and will handle repairs to all rolling stock from Winnipeg to the Atlantic. The cut on page 184 gives a good idea of the extent and layout of the individual components, all of which are dependent upon the central power installation herewith described, for power, light and heat.

The power house, like the other principal buildings, is a self-supporting steel structure, with walls of concrete as far as the window sills, from which point up they are of white brick. The building is 150 feet long by 110 feet wide, and is divided longitudinally by a brick fire wall into two parts 45 feet and 60 feet wide. The smaller part forms the boiler house, and the larger the engine room. The boiler house contains eight water tube boilers, by the John Inglis Co., Ltd., Toronto. They are of the Erie City vertical tube type, and are rated at 425 H.P. each. The working pressure is 150 lbs. There are four groups of two boilers each, three of the groups being fitted with automatic chain grate stokers operated by small vertical engines in the basement. The grate equipment was supplied by the Illinois Stoker Co., Alton, Ill. The fourth group is hand fired, and when the planing mill is completed and in operation, will consume all shavings, sawdust and scrap lumber.

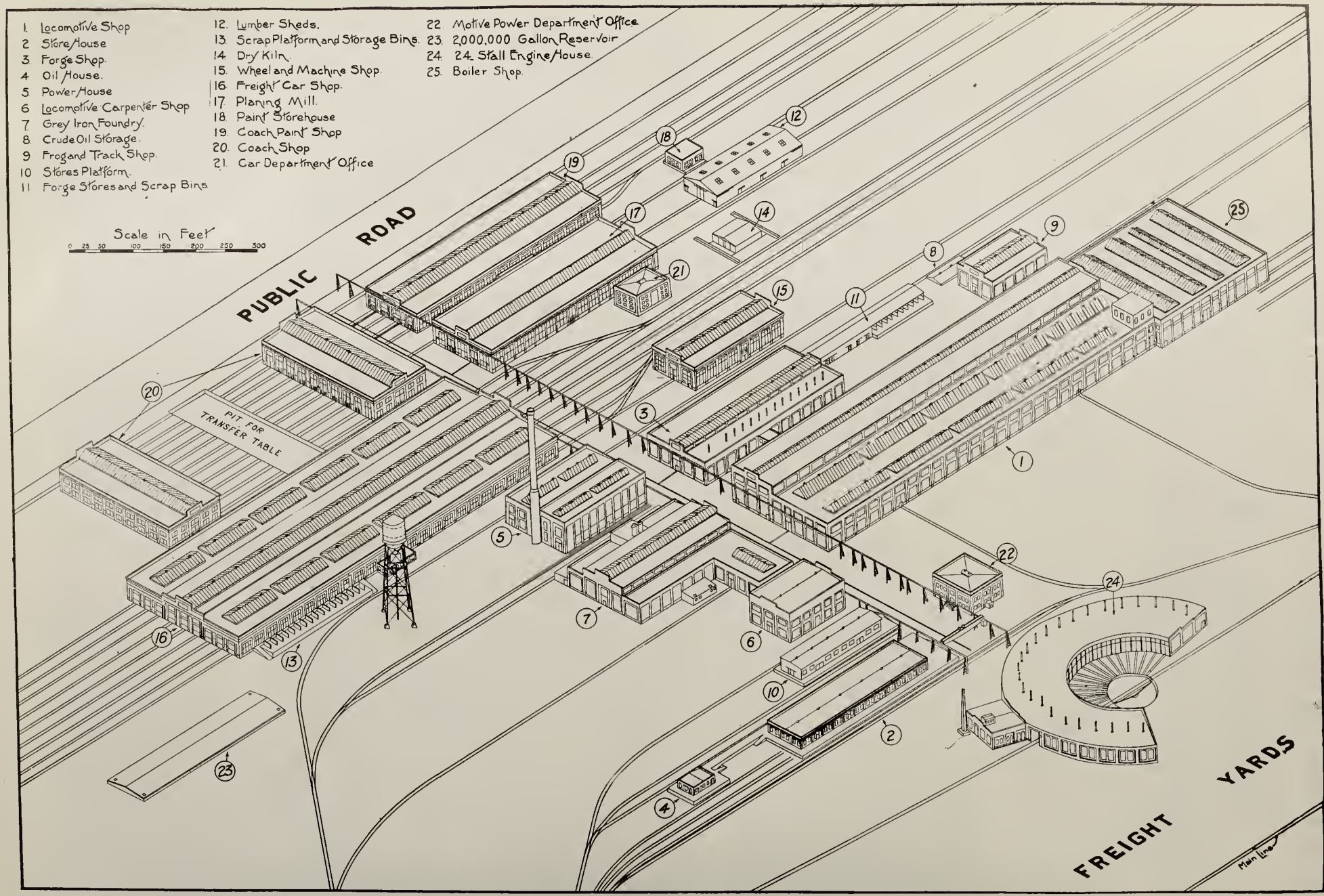
The boilers all blow off into a common blow-off main leading to a well situated outside the building and connected to sewer.

Chimney.

The products of combustion from all the furnaces pass into a steel breeching running overhead in a passage way between the back of the boilers and the fire wall previously mentioned. Natural draft is provided by a Weber reinforced concrete chimney, 210 feet high above ground level, by 11 feet internal diameter. The breeching enters the chimney about 12 feet above ground level by an opening 15 x 6 feet. The chimney has two 24 x 18 inch cleaning doors at the bottom, and stands upon a concrete

*Associate Editor, Toronto.

Interior of Power House, looking west. The engines are by the Goldie & McCulloch Co., and the generators by the Canadian General Electric Co.



ISOMETRIC PROJECTION OF THE NATIONAL TRANSCONTINENTAL RAILWAY SHOPS, TRANSCONA, MAN.

footing 30 feet square at the base by 11 feet deep. This footing rests upon eighty-four wooden piles, 25 feet long.

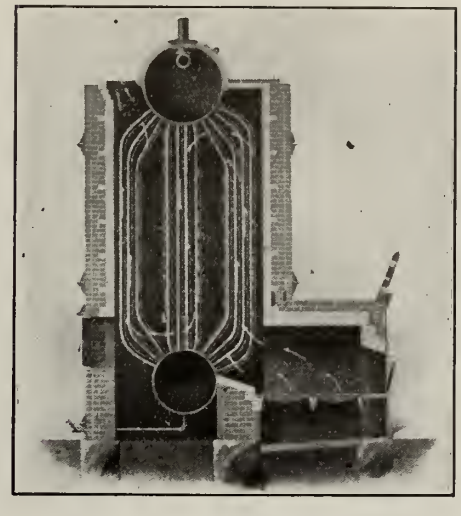
Coal and Ash Handling Equipment.

The automatic system of handling coal and ash is very complete, and the labor necessary in the boiler house is reduced to a minimum. Coal is brought in from the west end of the yards in hopper cars, which are weighed on track scales before reaching the power house. The cars then proceed on a track adjacent to the boiler house and ascend a ramp elevated 7 feet above grade level. The coal is here dumped into a steel receiving bunker, from whence it is taken by a belt conveyor to the crusher, situated in the boiler house basement. The crusher is driven by a 20 H.P. motor. The coal next passes to an endless chain bucket conveyor, driven by a 10 H.P. motor; and is carried to the overhead bins, of which there is one for each boiler. These bins are lined with fibricated asphalt supplied by the Interior Construction Co., Winnipeg. This consists of a mixture of asphalt, asbestos and sand, and it is expected to turn out an improvement on the usual concrete lining, which wears so rapidly under the weight and friction of the coal. From the overhead bins the coal descends by chutes to the stoker hoppers, so that from the time it is dumped from the cars to the time it reaches the grates it is handled entirely by automatic means.

The endless chain conveyor is also used for ash removal. Its horizontal run is, of course, in the basement, so that the ashes are merely raked out from the ash pits and discharge themselves through chutes to the conveyor, which elevates them in the same way as it does the coal, but is now tripped to deliver the ashes to a special concrete-lined ash hopper located overhead alongside the coal bins. From here the ashes pass by steel chutes to the cars outside, so that the same car which delivers coal may be used for removing ash, thus saving switching. The coal crusher and conveying apparatus was installed by the Jeffrey Manufacturing Co., Ltd., Montreal, and is of their latest type.

The Engine Room.

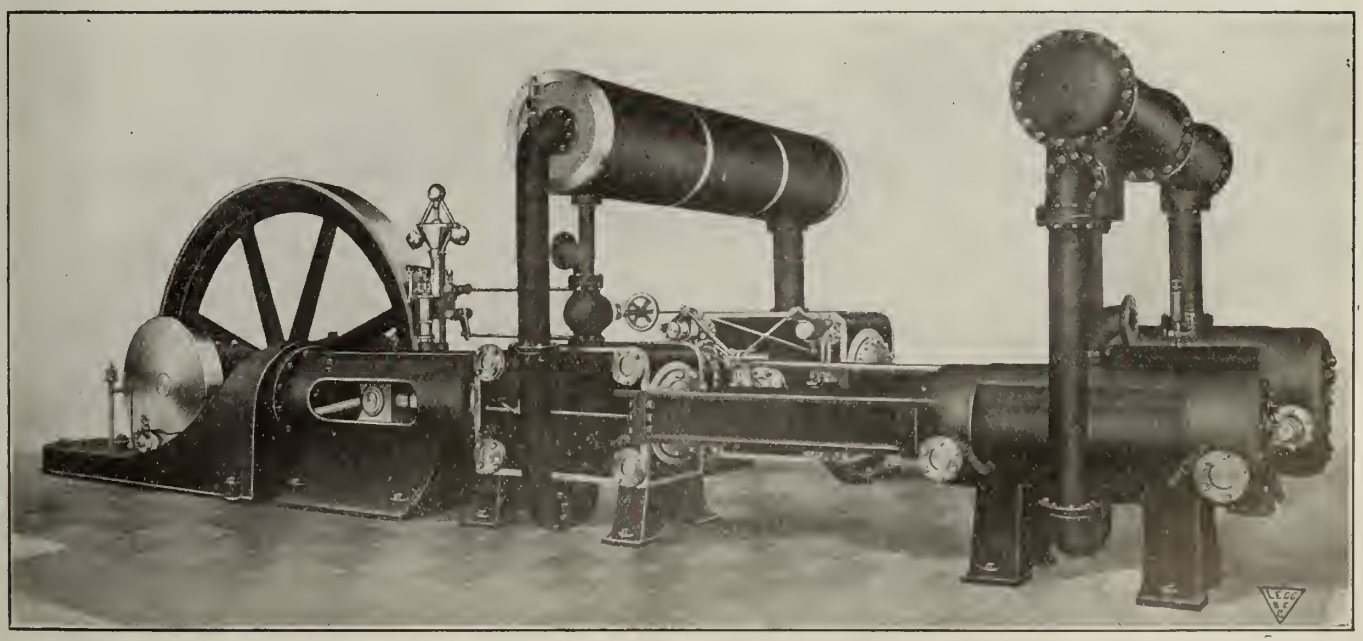
As above mentioned, the engine room is 150 feet long by 60 feet wide, the head room to the underside of the steel roof trusses being 30 feet. The walls for a height of 6 feet from the floor are finished with a coat of black paint; above this height they are whitewashed. The floor consists of standard maple flooring laid on top of a rough lumber under-floor, which in turn is laid on 4 x 6 inch timbers bedded in bituminous concrete. Ample lighting is secured by windows in the side and end walls, and by central skylights in the roof. The engine room is served by a hand-operated 10-ton travelling crane supplied by Geo. Anderson & Co., Ltd., Montreal.



SECTION SHOWING CONSTRUCTION OF ERIE CITY VERTICAL WATER TUBE BOILER.

All the generators are by the Canadian General Electric Co., and all the engines are by the Goldie & McCulloch Co., the nominal capacity of the plant being 2,050 kilowatts. There are three main units, each consisting of a cross-compound Corliss engine direct connected to a 3-phase generator of 500 K.W. capacity. These three engines have cylinders 21 and 34 inches in diameter by 30 inches stroke, and run at 150 R.P.M. A fourth A.C. unit consists of a 250 K.W. generator driven direct by an 18 x 30-inch simple Corliss engine running at 150 R.P.M. All alternating current is 3-phase, and is generated at 600 volts, 60 cycles.

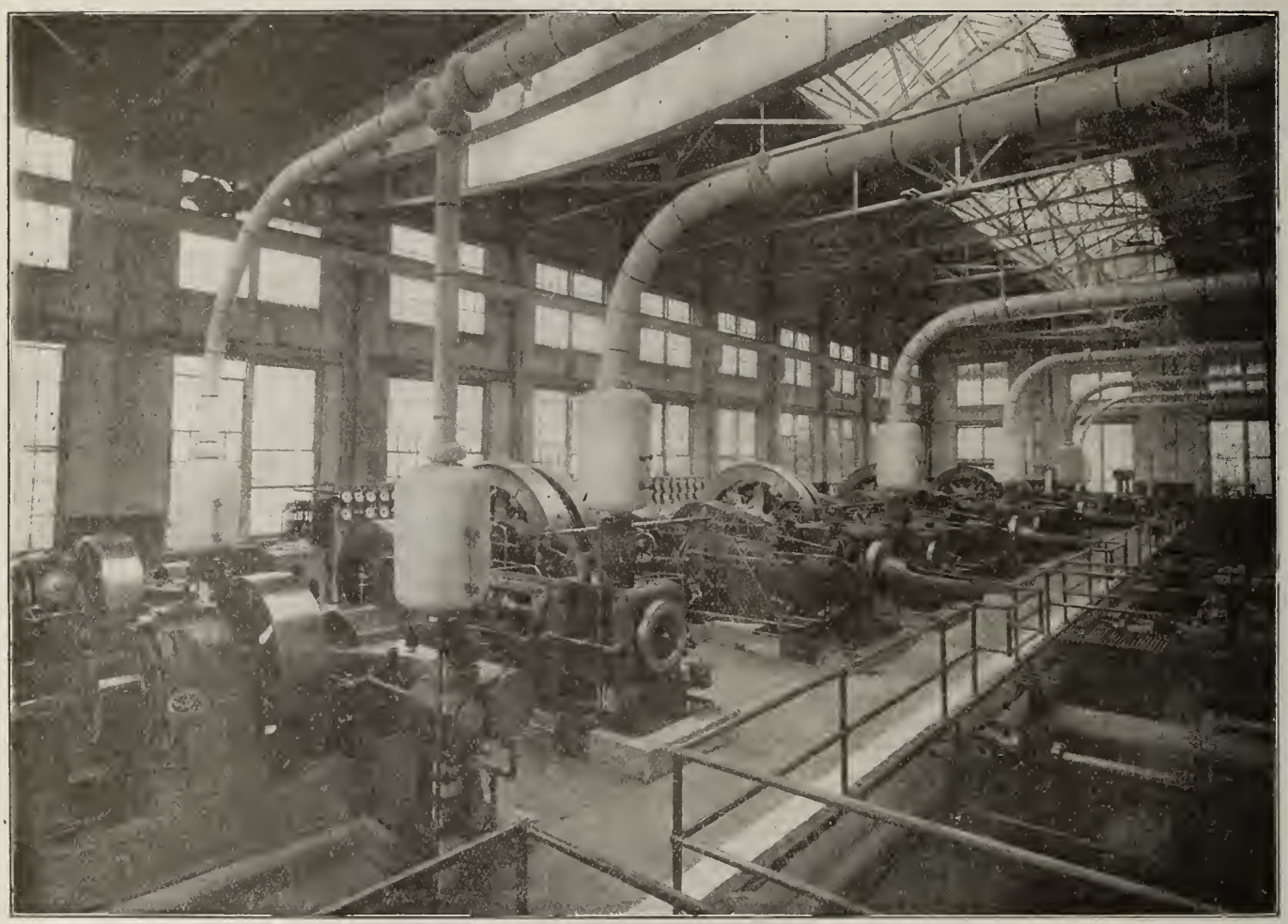
Duplicate exciter units for the four A.C. generators are located at the west end of the engine room, and consist of two Ideal high-speed engines (11 x 12-inch), running at 275 R.P.M., and direct coupled to continuous current, 125 volt generators of 65 K.W. capacity each. To supply current for the variable speed motors driving many of the larger machine tools there are two D.C. units. One of these consists of a 14 x 30-inch simple Corliss engine running at 150 R.P.M., direct connected to a continuous current generator of 150 K.W. capacity. The second unit is a motor generator set; a 225 H.P. induction motor takes current from the A.C. bus bar, and drives the generator at 900 R.P.M. The capacity of both units is the same —150 K.W., the current being generated at 250 volts. The object of the motor-generator set of course is to improve the power factor.



Horizontal Cross Compound Two-Stage Air Compressor, by the John Inglis Co., Ltd., Toronto.

At the east end of the engine room is installed the main air compressor unit. This was supplied by the John Inglis Co., and is a horizontal cross compound Corliss two-stage compressor, having a capacity of 1,600 cubic feet of free air per minute against a pressure of 80-120 lbs. per square inch.

The steam cylinders are 16 and 25 inches, and the air cylinders 24 and 14 inches in diameter, the common stroke being 36 inches. Both air cylinders are fitted with Corliss inlet valves and poppet outlet valves. The engine has double wristplate long range cut off on the low pressure steam cylinder and single wrist plate on the high pressure. Speed is regulated by a combination centrifugal and pressure governor, pressure being taken from the discharge of the high pressure air cylinder and working an oil packed plunger on the governor. Both air cylinders and heads are water cooled, as is also the intercooler between the two cylinders. Steam passes from the H.P. to the L.P. steam cylinder through a reheating receiver standing above the cylinders, and heated by live steam. The engine runs non-condensing, and was designed for a speed of 90 R.P.M.



Interior of Power House looking east. The two exciter units are seen in the foreground on the left of the illustration.

Pump Pit and Piping.

The wall dividing the engine room from the boiler house carries the main steam header on standard brackets. The header is of wrought steel, 12 inches in diameter, and has the branches riveted on. It is carried on the engine room side of the partition wall, and is connected to the boilers by 8-inch double bends. Steam pipes from the header to each engine have bends of large radius. The pipes to the Inglis air compressor and the two exciter engines are 4½ inch diameter, the other four engines having 7-inch pipes. All are provided with Crane separators.

The pump pit runs the full length of the engine room at the foot of the dividing wall, the bottom of the pit being 9 feet below the level of the engine room floor. It is provided with a 6-inch auxiliary steam header running the full length of the pit, and connected with the main header by two 6-inch vertical legs provided with separators. This auxiliary header of course supplies steam to various pump units in the pit. The main steam header also carries a 10-inch vertical leg connecting to the line which provides steam for the hammers in the forge shop, for driving the fan engines of the indirect heating system and for heating those shops which use direct radiation.

The exhaust header is 18 inches in diameter, and, like the steam headers, extends the full length of the pump pit. All engines and pumps exhaust into this, part of the steam afterwards passing through a Hoppes open heater and part being used in winter for the indirect heating system in the various shops. From the heater the exhaust passes up a 16-inch galvanized steel stack to the atmosphere. The heater can of course be cut out when necessary for cleaning or repairs.

Before dealing with the feed pumps it may be as well to trace the course of the feed water on its way to the heater. The source of supply for the service water throughout the plant is a 2,000,000 gallon reservoir situated about 500 feet distant from the power house. From this reservoir the water is pumped up to a steel water tower, the bottom of which is 125 feet above grade level. This tower has a capacity of 100,000 gallons, and is supported by four steel legs resting on concrete piers. The two pump sets which raise the water to the tower were supplied by the John McDougall Caledonian Iron Works Co., Ltd., Montreal. They are located in the

power house pump pit, and consist of duplicate 8-inch single stage horizontal turbine pumps, with extended bases. Each pump is direct connected on the same base with an 18-inch six-stage 70 H.P. horizontal Kerr steam turbine running at 1,500 R.P.M. The capacity of each set is 1,200 U.S. gallons per minute, against a head of 150 feet. From the tower the water passes to the main service pipe, and is thence distributed throughout the shops. The connection from the service pipe to the feed water heater is fitted with a reducing valve, which brings the pressure down to about 5 lbs. per square inch.

From the heater the feed passes to two 14-10¼-10 Blake horizontal duplex piston pattern boiler feed pumps mounted on cast iron bed plates. Each of these pumps has a capacity of 200 U.S. gallons per minute against the boiler pressure of 150 lbs. They are cross connected in such a way that they may draw either from the reservoir, the service line or the heater; and their delivery is cross connected to the two feed lines, so that all danger of breakdown is practically eliminated.

Protection against fire is provided by two Underwriter duplex fire pumps built by the John Inglis Co. The combined capacity of the two pumps is 2,000 gallons per minute against a pressure of 200 lbs. per square inch. Two Marsh steam-driven vacuum pumps deliver the heating returns to the feed-water heater, and a small Canton-Hughes pump takes care of the engine and separator drips, delivering same to the heater or to sewer, as desired.

No provision has as yet been made for softening the water; though it is probable that it will be found necessary to treat the boiler feed at least, if not the whole supply, since the water is very hard. It is pumped from the Red River to the 2,000,000 gallon reservoir, as will be presently described.

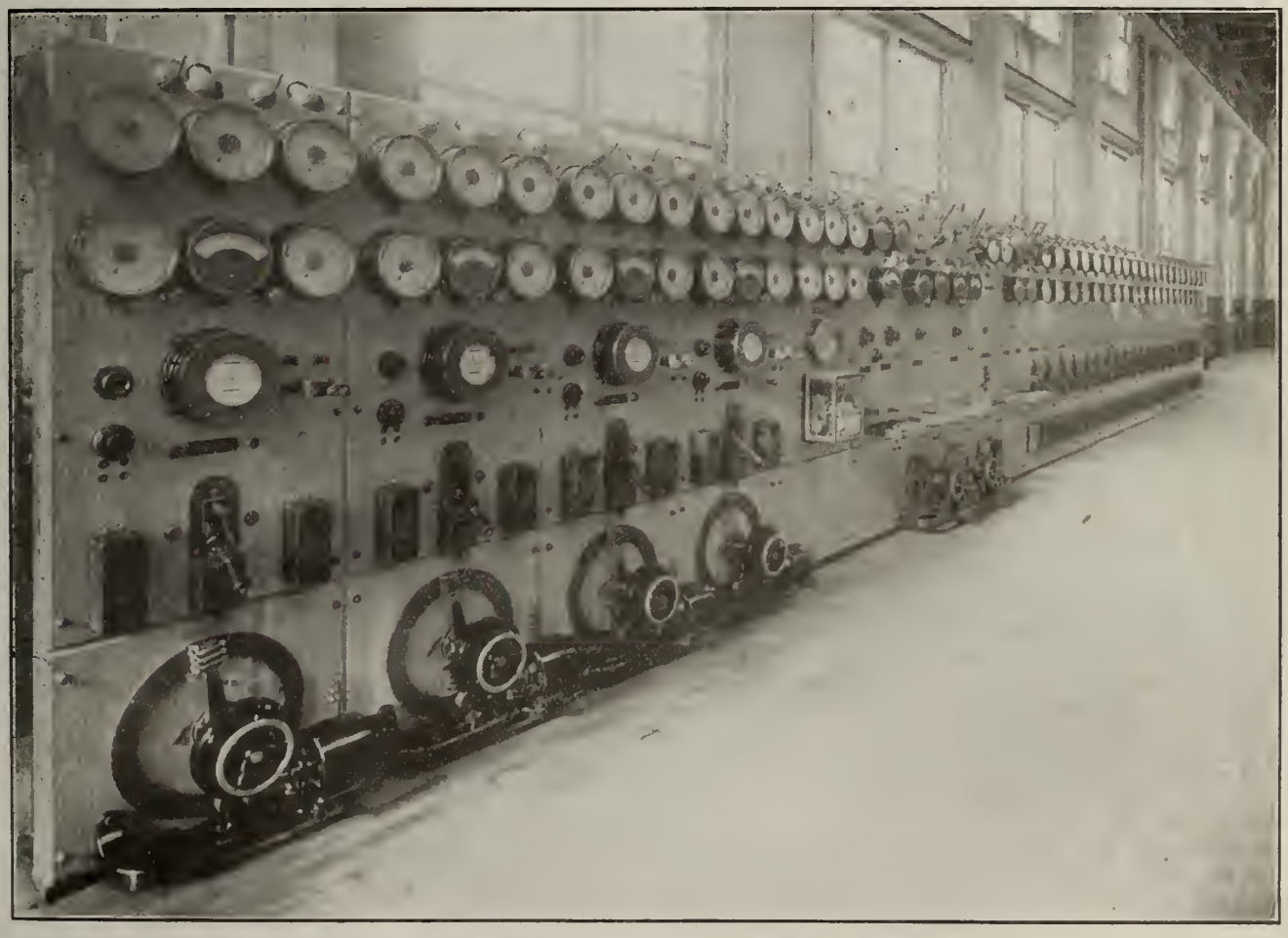
At the west end of the pump pit in the power house there is a 6-inch artesian well, 180 feet deep. A 4¼-3-36 Blake vertical deep well pump draws 40 gallons per minute from this well, and delivers it to a 10,000 gallon tank suspended below the main tank of the water tower From here it flows to the various drinking fountains throughout the shops, the Red River water being unsuitable for drinking purposes.

All valves and fittings on the steam, exhaust and water lines are of Jenkins or Crane make, the valves on the main steam lines being fitted with by-pass valves. The high and low pressure steam piping throughout the plant is thoroughly and neatly lagged with an efficient non-conducting material, and presents a very pleasing appearance. The various pipe lines are painted with distinctive colors to render their identification at all times easy. Thus the high pressure steam lines are colored white; low pressure steam, buff; heating returns, blue; compressed air lines, green; fire service, red; hydraulic pressure, brown; and general water service pipes, black.

The cylinders of the four Goldie & McCulloch engines are lubricated by Richardson automatic sight-feed oil pumps driven from the valve gear; while the Inglis air compressor is fitted with a Detroit sight-feed lubricator. All bearings are lubricated by the continuous gravity system, the oil flowing from an elevated tank to the various bearings, and from thence to a Burt unit type oil filter in the pump pit. From the filter a small steam pump elevates it once more to the tank.

The Switchboard.

The switchboard was manufactured and installed by the Canadian Westinghouse Co., Ltd. It is composed of twenty-one panels of blue Vermont marble, having a total length of 52 feet and a height



THE POWER HOUSE SWITCH BOARD, BY THE CANADIAN WESTINGHOUSE CO., LTD.

of 7 feet 8 inches. There are nine generator panels, the remainder controlling the various A.C. and D.C. feeders. The A.C. generator panels are equipped with an oil circuit breaker with inverse time limit relays, ammeters, voltmeters, indicating wattmeter, field ammeter and watt-hour meter. The rheostats for both A.C. and D.C. generators are electrically operated and have faceplates mounted on the sub-panels of the board. The total-load panel for the A.C. generators is equipped with ammeters, voltmeter, power factor meter and graphic recording wattmeter. All the A.C. feeders are controlled by oil circuit breakers with inverse time limit relays, and have an ammeter and indicating wattmeter in each circuit, two feeders being mounted on one panel. The D.C. generator panels have carbon-break circuit breakers, ammeters, voltmeters and knife switches. The two D.C. feeder panels are also equipped with carbon-break circuit breakers.

All A.C. meters on the board are Westinghouse type "F," the D.C. meters, type "FL," and the oil circuit breakers, type "B." A Westinghouse synchroscope is supported on a swinging bracket at one end of the board. Each panel has an engraved name plate, and the general finish of the meters and circuit breakers is polished copper on a black background, so that the board presents a very handsome appearance.

The Reservoir.

As already mentioned, the water supply for the plant is obtained from a 2,000,000 gallon reservoir, which is filled by a pumping plant situated on the banks of the Red River some 6 miles distant. The reservoir is of concrete, and is 270 feet long by 60 feet wide, the bottom being 21 feet below ground level. It is divided longitudinally into two tanks by a central wall of reinforced concrete, resting on a footing of similar material. This central wall enables one-half of the reservoir to be cleaned out while the other half is in use.

The side and end walls are of plain concrete, as are also their footings. The central wall is 30 feet high, while the side walls are 25 feet in order to give sufficient slope to the roof. The latter consists of two thicknesses of 2-inch tongued and grooved planking resting on steel girders and purlins, and is covered with 4-ply waterproof roofing.

Flooding is provided against by a 12-inch cast-iron overflow pipe connected to sewer. Access to the interior of the reservoir is had by means of four hatches in the roof, iron ladders extending to the bottom of the tanks. The interior is wired for electric lighting, and heat is provided in winter by pipe coils taking steam from the low pressure line.

The pumping station on the banks of the Red River, from which the 2,000,000 gallon reservoir is filled, contains a producer gas driven plant consisting of two complete units in duplicate. Each unit comprises producer, scrubber and 60 H.P. single cylinder gas engine driving a vertical triplex force pump fitted with extra large suction and delivery valves, which are readily accessible. Each pump has a capacity of 40,000 gallons per hour, against a head of 50 feet. The suction lines run out into deep water and are 14 inches in diameter, the delivery line being 12 inches. The engines are cross connected with the two producers, and the pumps are cross connected with the two suction lines. This installation was supplied by T. H. & J. Daniels, Ltd., Stroud, England.

Sewage Pump House.

A main sewer surrounds the plant, to which connections are made from the various shops. As there is not sufficient fall from the site to the Red River for a gravity flow, it has been found necessary to put in a pumping station to force the sewage to the river. The pump house is located 1,400 feet west of the storehouse, and is not seen on page 184, being outside the boundaries of the plan there shown. It is a concrete building, 31 feet by 28 feet inside, and rests on concrete foundations. Below the floor is a large sump, the bottom of which is some 25 feet below ground level. Into this the main 42-inch sewer discharges; the sewage being pumped thence to the Red River by two submerged pumps driven by direct connected vertical motors, located on the floor above. The larger of the two units is a 26-inch vertical centrifugal pump, having a capacity of 16,000 Imperial gallons per minute against a head of 48 feet. It is direct driven by a 350 h.p. 3 phase 60 cycle 550 volt motor, provided with a thrust bearing to take the weight of the rotor only. The smaller unit consists of an 8-inch vertical centrifugal pump direct driven by a 30 h.p. motor of the same type. This outfit was designed for a capacity of 2,000 Imperial gallons against a head of 15 feet. It will be in operation at all times, while the larger unit is intended to take care of storm waters, etc. The pumps are automatically started and stopped by means of floats, which operate the motors by means of two Cutler-Hammer automatic starting panels. Hand control is also provided for use when necessary. The switchboard is of blue Vermont marble and has a panel for each motor, in addition to the automatic starting panels. Current is brought from the power house by a lead and paper covered feeder, laid in a tile conduit. The 350 h.p. motor panel has the following equipment:—one 400 amp. 3-pole single throw automatic oil switch; one 500 amp. Weston ammeter, and one 600 volt Weston voltmeter. The other panel has one 50 amp. automatic oil switch; one 60 amp. Weston ammeter, and one 600 volt Weston voltmeter.

The pumps were constructed by the John McDougall Caledonian Iron Works Co., Ltd., Montreal, and the motors by Allis-Chalmers-Bullock, Ltd., Montreal. The two pumps are connected to one discharge pipe, 42 inches diameter. This pipe, some 6 miles in length, is provided with necessary manholes, vents, etc.

NATIONAL POWER HOUSES.

PRESENT-day practice does not represent a final solution of the electricity supply problem. The multiplicity of power houses with their respective staffs is not economical, and the abilities of engineers at present engaged in running comparatively small generating stations would find full play in other directions if a bulk supply were available at a price low enough to secure its exclusive use in all domestic and industrial operations. The complete realization of such an object would be possible only by erecting upon the coal fields of the country, electric generating stations on a much bigger scale than anything yet attempted. From an economic point of view no question was more important in the United Kingdom than the efficient use of coal, and no economy was so far-reaching in its effects as that of fuel, which constituted the vital force of almost every branch of industry. A gigantic scheme of this character called for the active co-operation of the Government with the existing supply authorities, and there were few home problems that could be more profitably dealt with by the legislature, or that would confer greater benefits upon the nation.

National power houses, built on the coalfields and on other sites to which coal would be cheaply transported by water, would supply the power for all extensions in existing areas, and would gradually assume the whole of the supply, as the plants in local works became worn out or obsolete. Such power houses would be equipped with high-pressure steam turbo-generators of, say, 25,000 and 50,000 kw. sizes. They would be inter-connected and distribution effected at, say, 100,000 volts to sub-stations. Transmission at this pressure was already successfully accomplished in Colorado under the most severe conditions.

The Question of Steam Generation.

It was the generation of steam that called for a radical change in present-

day practice. Engineers had too long been content to use boiler plants, furnishing on an average of from 2lb. to to 3lb. of steam an hour per square foot of heating surface. Such practice involved the use of enormous boiler installations, out of all proportion to the size of the generating plants, and reference to the layouts of modern works, equipped with from 10,000 to 20,000 kw. units of power, showed a separate boiler house for each generating plant. These boiler houses were built end-on to the power house, and imposed a heavy capital cost for boilers, buildings flues, and chimneys. They also involved heavy losses in boiler, steam pipe, and flue radiation.

The solution of these difficulties appeared to lie in the introduction of gas firing, by means of flameless surface combustion on the lines first discovered by Sir Humphrey Davy, and more recently developed and described by Professor Bone. So far as investigations have gone at present, it was shown that an evaporative duty from boilers exceeding 20 lb. of steam per square foot of heating surface could be obtained easily with a thermal efficiency corresponding to the transmission to the water in the boiler of nearly 95 per cent. of the energy represented by the net calorific value of gas. At a slightly lower efficiency the evaporation might be increased from 20 lbs. of steam to 30 lbs. of steam per square foot. On these high duties the internal boiler surfaces were stated to be self-cleaning; and the scale in thin flakes became detached and was deposited in the bottom of the boiler. The boiler installation would be comparatively small and the steam range short, as all the auxiliaries would be driven by internal combustion engines.

The Supply of Low-Pressure Steam.

Many of the largest industries in the country—probably the cotton, woollen, dyeing, chemical, distilling, and brewing trades used immense quantities of low pressure steam in their various manufacturing processes. Steam for such industries could be supplied from the national power houses at less cost than it could be produced by the manufacturers themselves. Irrespective of the large economies and advantages effected by a distribution of power on national lines, such a market for low prsesure steam would have a startling effect upon the economy of electrical production, as it would at once eliminate the enormous losses involved in condensers. Just as the Niagara and other large hydro-electric schemes, by reason of cheap power, attracted and promoted industries in their immediate vicinity, so national electric power houses, able to supply vast quantities of low-pressure steam at cheap rates, would attract and promote in their immediate vicinity those industries wherein steam formed one of the chief items in the manufacturing process. It was remarkable that business in this direction had not already been developed by power stations operating in the textile districts. In many areas it would be much better to invest capital in thus selling the condenser losses than in the erection of costly cooling towers and condensing plants.

There were many district steam-heating schemes in operation in America, and in numbers of instances the revenue from the heat distribution was larger than that from the sale of electric power. One of the most convincing proofs of the value of a low-pressure steam-heating business was furnished in the case of Lockport, New York, where approximately 300 buildings were supplied with heat during the colder months of the year. The company purchased electricity in bulk from Niagara Falls at one quarter of a cent per kw. hour; nevertheless, in the cold season, with coal costing $3.18 per ton (English ton), it paid the company to operate their own local steam generating plant and to sell the exhaust steam in the city.

From the heating business alone, during the cold season of about 5,400 hours, they derived an income approximately $46,875.

The foregoing is an abstract from the presidential address delivered recently before the Incorporated Municipal Association, at Leeds, England.

OIL BATHS FOR GEAR BOXES.

AN interesting sidelight is thrown on the question of flooded lubrication for machine tool gear boxes in the following communication to Page's Weekly by F. W. S., Disbury, Manchester, England:—

A new machine driving through a geared driving box was undergoing efficiency tests. All the gears on the lower shaft of the driving box dipped into oil, contained in the lower part of the box. In testing, the splash of oil was so great that the force was sufficient to cause leakage at various joints. As a consequence, it was decided to carry on the test with a lowered oil surface. After completion of the test, which was to ascertain the power necessary to effect certain cuts, an examination of the power curve showed a big discrepancy, and this discrepancy appeared at the very point at which the change in oil surface had been made; hence it was decided to duplicate the tests last made, after replacement of the oil to bring it to the former level. The power figures were now found to increase from about 10 to 20 per cent., according to the speed, the conclusion drawn being that the additional oil resulted in this amount of loss.

Finally, tests were made to show the differences caused by varying the oil level, even to the extent of suppressing the splash altogether, with the result that the power needed was seen to increase uniformly as the oil level was raised. There is no doubt the extra power was entailed by the additional work to be done in moving the oil, all the gears acting, as it were, as pumps, and taking the power that a pump would require to do the same amount of work. After running some little time entirely without oil, power was found to increase, and examination showed that temperature at the bearings gradually increased. As a result of the tests, it was decided to reduce the oil level to the minimum requisite to ensure efficient lubrication, with an average saving in power of some 15 per cent.

Does not this suggest a return to some form of syphon or drip lubrication? A constant loss of, say, but ½ h.p. is a matter deserving of some little consideration and would well pay for the little additional cost of fitting special means for lubrication, and the trouble entailed in daily oiling.

STATIONARY ENGINEERS AND THE TITANIC DISASTER.

THE following resolutions have been passed by the National Association of Stationary Engineers of Milwaukee, U.S.A.:—Edwin Reynold's Association No. 1. Being in full sympathy with our fellow craftsmen of the marine service, who, following the call of duty, perished in the sad disaster which led to the sinking of the steamship Titanic, April 15, 1912, we deem it meet and just that their bravery and sad ending be duly recognized, therefore, be it

Resolved, by this Association, in regular meeting assembled, that our heartfelt sympathy for the brave boys lost, and for their bereaved relatives, be hereby expressed, and may they find their reward in that great beyond where the One above watches over all, and may the comforting Angel of Pity spread her wings over the sorrowful relatives; and be it further

Resolved, that these resolutions be spread upon our minutes, and a copy forwarded to the Supreme Body of Marine Engineers of England, a copy to the Board of Trade, London England, a copy to the Supreme Body of Marine Engineers of the United States, and a copy to our official paper, the National Engineer.—Approved, Ferd. Krieger, President; J. W. Downing, Secretary, No. 1. Milwaukee, Wis., May 4th, 1912.

FEATURES OF WATERWORKS PUMPING STATION OPERATION.

THE following article is an abstract of a paper read before the Illinois Water Supply Association by M. M. Symons, Chief Engineer of the Danville Water Company.

Before our filter system was installed, it became necessary to clean out our suction well. This well is 48 ft. diameter and 19 ft. deep. It is walled with brick and the bottom is 12 ft. below the river bed. There is a 20-in. cast iron pipe extending from the river into the well, turning down just inside to the bottom, continuing to the centre and discharging through a 20-inch tee looking up. The deposit having settled for 13 years, had accumulated to a depth of 9 ft. at the outside and 3 ft. in the centre. The pumps took suction at the side, so the agitation from the action of the pumps gave us turbid water when we should have had clear. In connection with our system we have a reservoir which holds 7,000,000 gals. The water was used from this reservoir during freshets. One of our pumps being connected directly with this reservoir enabled us to cut our suction well entirely out of use. The first thing we did was to dig a pit 10 ft. deep on the outside of the well, cut a hole in the wall and then put a 6-in. centrifugal pump in this pit. The pump was belted to an ordinary threshing engine, and the suction pipe was made up with a swing joint so it could be raised or lowered at will. A fire hose connection was made in the station and the hose carried out to raft in the well. Two men on the raft handled the hose. The water pressure of 100 lbs. stirred the mud up nicely, and it was then pumped out by the centrifugal pump. Water was admitted from the river, so as to float the raft and also to furnish enough water to keep the pumps in operation. At the end of three days, the work was completed.

Intake Troubles.

Our intake formerly consisted of a 20-in. cast iron pipe, extending out into the river. It had the customary ¼-in. mesh copper screen on a sliding frame, after the fashion of a window sash. Being a little below the bed of the river, it gave us more or less trouble from stoppage. During one of our April freshets, the water was quite high and lasted several days; so long that our supply of clear water was exhausted. It became necessary to turn the river into the suction well. Usually when changing from reservoir to the river, I filled up the suction well and flushed the intake. This time I did not have water enough to overcome the head in the river, so had to open up without flushing; but to my surprise when the gate was open I got no water, there being 8 ft. of water over the intake at this time. Well, something had to be done, and done quickly, so donning some old clothes, I proceeded to make an examination of the screen.

Going down in 8ft. of water in April is not very pleasant. After getting down, I found the screen covered with 2 ft. of sand and a good strong current running. The next thing was to remove the sand. A shovel or spade could not be handled in that depth of water in such a strong current, so getting a common garden trowel, I went down again and commenced the task of digging the sand off. After 13 hours I was able to get a clean spot on the screen, and then by means of a steel hook, clipped to the screen and connected by a chain to a 2,000-lb. chain hoist, we pulled the screen off. Since one minute is about as long as you can hold your breath, you can readily see that the work was very exhausting. We were, however, successful in getting the water.

At another time, this same intake gate gave us trouble. We had an A-frame dam with a 40 degree pitch anchored to a stone pier. The intake pipe came out through the pier, extending through the toe of the dam, up stream to the screen. The shut-out gate was under the dam. A common 6-in. water main came up through the sheathing on the dam, about 3 ft. out from the pier to enable us to open and close the gate. In January, we had our usual thaw out and freshet. The ice went out and also the valve stand. The valve was shut, of course. The thing to do was to get the gate open, and to get it open we had to get down to it. We built a triangular shaped box, open top and bottom, 12 ft. long at the base, 7 ft. at the top and 5 ft. wide, the sides being cut to the same pitch as the dam so as to fit down over it. This was built with an apron extending up stream to the toe of the dam so as to be partially submerged. Thus the weight of the water helped to hold the box in place. We anchored the box up stream by a 1¼-in. line, setting the crib on skids and sliding it over the pier. As it had been built in the shape above described, the water running against it, made it hug the sheathing on the dam. By putting in anchor bolts from the top to the underneath side of the dam and calk the joint where the sides of the box rested on the dam, we accomplished our purpose.

Ice Troubles.

Our present dam is constructed with four Tainter gates, 10x14 ft., to enable us to control the flow of the river. They have the usual form of hoisting gear, consisting of a worm screw and chain drum, making it fairly easy for one man to handle them. When the gates were installed, a steam line was provided for the purpose of thawing the ice which naturally forms on any type of gate. We have had no difficulty heretofore in thawing the ice and raising the gates. This winter, however, has been a very severe one. There was no necessity for raising the gates until the middle of January. Then a thaw occurred and it looked as if the ice was likely to break up. Upon attempting to thaw out the gates it was found that ice had formed on the vertical face to a thickness of 14 ins., extending from the surface of the water to bottom of the gates, a vertical depth of 12 ft.

I commenced to thaw the ice from the gate and had the top apparently loose. I commenced to turn the gear, and it broke and fell off into the water. There was none nearer than Dayton, Ohio. I put the men at gate one; they worked awhile . and while I was in the station, one of the men thought he would take a strain on the chains. Well, he took it and that gear was broken; and there were two of them out of commission. I sent it to the shop and had it repaired. By the time it was back, I had fished the other one out and had it repaired and put on; then gave strict orders not to attempt to raise another one as long as there was any ice visible. The down stream side of the gates are exposed to the weather. The front side of the gates are under 12 ft. of water. This freezing to the side piers, made thawing them out very difficult work, but bending a 3¼ in. pipe the same arc as the front of the gate facilitated the work, and after five days of cold, disagreeable work, we succeeded in getting them open. This shows the necessity of thawing the ice periodically and not allowing such a heavy accumulation to form. Since then, by a little work from time to time, the gates have been kept free and ready to raise in case they should be needed immediately to take care of the moving out of the ice in the river.

Oil Removal From Condensed Water.

The present management on taking charge of the Danville plant, found the tail water from the condensers going into the sewer, and on investigating, found that the condensed water returned from the pumps to the boilers contained oil which was left in the boiler. Condensed water is too valuable for boilers to waste into a sewer, so we began to experiment a little. The first thing was to reduce the oil about 50 per cent., then by catching some of the water in clean pails and letting it stand for 24 hours we could see the amount of oil on top and get a line

on it. The company was contemplating putting in a filter of a very elaborate design with linen filtering tubes and a sand bed which would cost in the neighborhood of $500. The superintendent suggested that we make one ourselves, and see what results we would get.

We had an iron tank 4½ ft. x 4½ ft. x 5 ft. made of ¼-in. plate, this tank being an old exhaust tank, not in use. In the store room there were 100 of the New York Continental Jewell strainers, which we used for our strainers. Taking 2½-in. nipples and 2½-in. x 1¼-in. tees, a header was made to fit inside and along one side of the tank. From this header were laid five 1¼-in. pipe laterals extending across the bottom of the tank, and into these laterals the filter strainers were screwed on 7-in. centres. The strainers were covered with 4 ins. of gravel and about 2 ft. of sand from the filter beds. Then, in order to prevent the water from going through too fast, the discharge pipe was made with a vertical riser coming up on the outside of the tank, higher than the sand on the inside, and still leaving a good head in the tank.

This filter is washed just as the large filters are washed, by reversing the filter process; that is, by shutting the inlet to filter and forcing clean water up through the strainers and sand bed. It was put into operation on our No. 2 pump, and after running awhile we found it so satisfactory that the No. 1 pump discharge was piped to it. The trap from the heating system was also piped to it, as we use exhaust steam in the heating system. The cost of the installation was $8.35 instead of $500. It has been in use over two years with no trace of oil in the boilers.

Economies.

The writer has in his plant four boilers:—two horizontal tubular, 18 ft. x 6 ft., with 70-4-in. tubes; two Scotch marine boilers, one 8 ft. x 13 ft. with a 50-in. Morrison corrugated furnace, and one 12 ft. x 14 ft. with two 42-in. Morrison furnaces; the latter having a Hawley down draft grate attached to it, making it the most economical boiler in the plant. In rolling the tubes, three of them split and had to be removed. The usual method of repairing tubes in such cases is to weld them out. On Tuesday it was found that the shop could not do the work for 10 days. It was decided that new tubes be put in for economy's sake. Wednesday noon, the boiler was under steam and in operation. The tubular boilers consume 4,000 lbs. more coal in 24 hours than the Hawley furnace. We would have been without the Hawley furnace nine days, and would have used 36,000 lbs. more fuel at $1.60 per ton, amounting to $28.80. The new tubes cost $4.60 each, less $1.50 for welding the old one, making the actual cost of the new tubes $3.10, or $9.30 for the three. The labor of putting them in was the same in both cases, making a clear saving for the company of $19.50, or 48 per cent. on the investment. At another time, changing the exhaust of a boiler feeder from the sewer to a Berryman heater, raised the temperature of the feed water 40 degrees, thereby saving 640 lbs. of coal in 24 hours. With coal costing at that time $1.10 per ton, a saving of 116.68 tons amounted to $128.48 annually. It cost $1.60 to make this change.

At another time, the writer experimented with the different ways of running packing on an outside packed plunger pump. The plungers were 12½ in. diameter. I found that by running them with a good slip as against no slip, made a difference of 6 h.p. With our rate of evaporation, and coal costing $1.25 per ton, a saving of $118.12 per annum was in favor of plungers slipping.

On taking charge of a central station, I found the feed water heater running over in the sewer continually, keeping the water at an average of 110 degrees temperature. After having stopped the waste, the feed water was raised to an average of 200 degrees. The plant was putting out on an average 42,000 k.w.h. per day, consuming 121 tons of coal, or an average of 6 lbs. per k.w. After the change there was a reduction of coal to 5½ lbs. per kw.h., a saving of 10½ tons at $1.10 per ton; amounting to $11.50 per day, or $4,197.50 per year. In other words, a 5 per cent. saving on $83,950.

JACKETING A STEEL WATER TANK.

Jacketing a steel water tank with concrete is described in the annual report of Mr. Fred J. Fischer, chief mechanical engineer of the Los Angeles water department. For some time the Edendale section has been supplied from a large steel tank having a capacity of 528,000 gallons. While this tank was originally built with a liberal factor of safety, recent unexplained failures of tanks of similar construction in various parts of the country determined the department to be doubly safe. The capacity of the tank was increased to 593,000 gallons by adding 5ft. to the height, and the steel shell was then encased in reinforced concrete, the reinforced concrete walls of themselves being of sufficient strength to withstand the hydraulic pressure with an ample factor of safety. This improvement, Mr. Fischer points out, has meant the replacement of an unsightly black steel tank with a concrete structure simple yet commanding in appearance and serving for a landmark that is visible for many miles up the San Fernando valley.

WHEN IS A BOILER IN ITS WEAKEST CONDITION?

A BOILER is in its weakest condition when the plates, bolts, braces or rivets of which it is constructed become weakened to such an extent that the internal force or pressure equals the tensile strength of the material at the weakest section or sections. In this condition, strains due to varying temperature will cause rupture and an explosion, the volume and destructiveness of which would be in accordance with the size of the boiler and the pressure carried therein.

The moment a boiler is placed in service it gradually becomes weaker, due to the destroying forces continually acting upon it. These forces are of both a chemical and mechanical nature. Corrosion and oxidation are continually acting on the material from which a boiler is constructed, and take place both internally and externally, these processes being the two most serious and subtle causes of weakening to which a boiler is subjected. Evidences of these are most noticeable in the grooving and pitting of plates, and more especially at locations most subject to deposits of mud, scale and organic substances. Expansion and contraction also play a very important part in the destroying and weakening of a boiler, more especially when concentrated at any one point, such as at sharp bends or flanges in the plates where the inner and outer sheets are subjected to different temperatures. Constant working or bending of bolts, flanges or angles, however slight, will sooner or later destroy the fibers in the material at points subjected to it, causing crystalization, cracking, and leaving same more susceptible to the chemical action of the feed water.

It is therefore obvious, in your committee's opinion, considering the numerous ills which a boiler is heir to, that only thorough examination by competent inspectors who understand the construction, nature of defects, and remedies to be applied, will maintain a boiler in a safe working condition. In conclusion, your committee wishes to state that in their opinion the elastic limit of the plates, braces, etc., used in the construction of a boiler should be considered, rather than the tensile strength.

The foregoing is an abstract from a committee report presented at the Master Boilermakers' Sixth Annual Convention held in Pittsburg, Pa., May, 1912.

C. A. S. E. Convention Arrangements at Belleville, Ont.

The opportunity for intimate personal contact with its Executive on questions of more or less high import is once more afforded the various branches of the Canadian Association of Stationary Engineers through their accredited representatives, and while "all work and no play makes Jack a dull boy," we are of opinion that sufficient of the social and intellectual feature has been provided to ensure for all who will be present at the Belleville functions a pleasant and profitable time.

THE 23rd Annual Convention of the Canadian Association of Stationary Engineers will be held in the Town Hall, Belleville, Ont., from Tuesday, July 23rd until Thursday, July 25th, inclusive. As in former years, the C. A. S. E. Exhibitors' Association will contribute to the educational and entertainment features of this important function by having on hand a representative display of power plant literature and equipment, and by the provision of a sports programme and smoking concert on one afternoon and evening. The officials of Belleville Lodge, No. 34, C.A.S.E., have been anticipating this Convention, and it will be noted from the programme of arrangements herewith that a pleasant and profitable time is in store for delegates and others who may find it convenient to attend.

City of Belleville.

The City of Belleville is located on the main line of the G.T.R., between Montreal and Toronto and boasts one of the largest roundhouses in the Dominion; employment being found for about 1,000 men. It is also the terminal point of the Midland Railway Division of the G.T.R. which connects with the main line of the C.P.R. at North Bay. The C.N.R. has recently built a station here, and in the near future the C.P.R. will parallel a line with that of the C.N.R., thereby giving Belleville the service of our three great transcontinental railroads. During the season of navigation, Belleville has shipping connection with the east, and also with all western ports via the Murray Canal.

JAMES STOTT,
President, Belleville Lodge No. 34, C.A.S.E.

F. H. CHESHER,
Chairman Belleville C.A.S.E. Convention Committee.

Convention Programme, July 23.

11 a.m.—Grand opening in which all delegates and visitors (including ladies) will take part at the City Hall.

1.30 p.m.—Delegates and visitors will assemble at City Hall and proceed to the Steel Company of Canada's plant, where they will be shown through by Mr. Thos. Moore, local manager.

3.30 p.m. — C.A.S.E. delegates begin their sessions.

8 p.m.—Grand banquet and entertainment will be tendered to delegates and friends.

Convention Programme, July 24.

9 a.m.—C.A.S.E. delegates in session.

1 p.m.—Inspection of exhibits.

2.50 p.m.—Delegates and visitors will proceed to Queen Victoria Park, where they will be entertained by the C.A.S.E. Exhibitors' Association.

8 p.m. — Open smoker of C.A.S.E. members and exhibitors at which papers will be read pertaining to the profession.

Convention Programme, July 25.

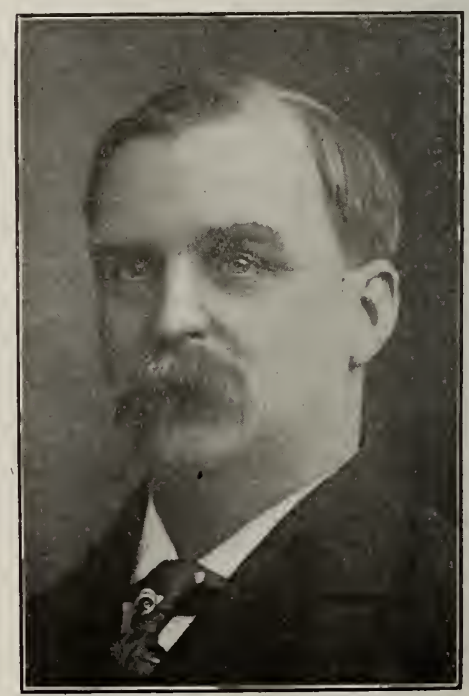
9 a.m.—C.A.S.E. delegates in session.

1.30 p.m.—C.A.S.E. delegates in session for installation of officers, presentation of past president's jewel and general closing ceremonies.

Exhibitors.

S. F. Bowser & Co.
Joseph Dixon Crucible Co.
Dart Union Co.
Cling Surface Co.
The Power House.
Lunkenheimer Co.
Goldie & McCulloch Co.
H. W. Johns-Manville Co.
Greene Tweed & Co.
Morehead Trap Co.
Peerless Rubber Co.
Canadian Fairbanks Co.
Canadian Manufacturer.
James Morrison Brass Mfg. Co.
Garlock Packing Co.
Canadian Steam Boiler Equipment Co.
Jenkins Bros.

A cordial invitation is extended to all engineers who can find it convenient to take advantage of the opportunity afforded of familiarizing themselves with the latest developments and improvements in power plant equipment.



W. COOKE,
Secretary, Belleville Lodge, No. 34, C.A.S.E.

Exhibitors' Day Programme.

The following, among other events, will constitute the entertainment features provided by the Exhibitors' Association in Queen's Park on Wednesday afternoon, July 24: Baseball game, Engineers vs. Exhibitors;hammer and nail race for ladies; soda biscuit race with whistling accompaniment; chariot race between teams of 10 men each, selected from among engineers and exhibitors. Other events will include a fat man's race, 100 yards dash, smoking race, and a baseball match for ladies.

22ND CONVENTION CANADIAN ELECTRICAL ASSOCIATION.

THE 22nd Annual Convention of the Canadian Electrical Association met at the Chateau Laurier, Ottawa, on Wednesday, Thursday and Friday, June 19 to 21 inclusive. Eleven years have elapsed since the association convened in the Capital City, and not only has the scope of the electrical profession become much enlarged and extended but in the same period, the organization itself has assumed a power and strength hardly anticipated by those responsible for its birth. The report of Mr. T. S. Young, Hon. Secy., showed the membership at May 31, 1912, to be 586.

Reports by the meter and commercial committees, and the reading of papers by Professor H. L. Barnes, D.Sc., McGill University, Montreal, and by Mr. J.

C. J. PEPPIN,
Secretary, Convention Committee, Belleville, No. 34, C.A.S.E.

G. Henninger on "The Influence of Ice on Water Power Development," and "Recent Developments in Lamps and Reflectors," respectively, constituted the business proceedings of the opening day. The discussion on Mr. Henninger's paper and the reading and discussion of a paper by Mr. S. Bingham Hood, entitled "Construction of Distribution Systems for Outlying Districts and Smaller Plants," together with an executive session, at which the new officers were elected, formed the business features of the second day's work. A moving picture illustrated paper on "Underground Construction," by Mr. G. M. Gish; papers on "Watthour Meters—Past and Present," by C. W. Baker; on "Commercial Electric Heating," by McAllaster Moore; on "New Business," by Mr. Thomas F. Kelly, and on "The Power Factor, its Influence and Effect," by Mr. D. H. Ross, concluded the business activities of the Convention proper on the closing day.

The concensus of opinion among those present, concerning both the business and social features of this annual gathering, expressed the belief that it was the most enthusiastic and profitable of the many meetings previously held, a circumstance largely due to the high quality of the papers read and to the magnificent hospitality of the City of Ottawa in an individual and collective capacity.

GROUP PICTURE OF DELEGATES AND FRIENDS, CANADIAN ELECTRICAL ASSOCIATION CONVENTION AT OTTAWA, JUNE, 1912.

ECONOMICAL WORKING OF STEAM BOILERS.

A DEVICE for the consumption of smoke in boiler furnaces and for economizing the heat, installed in a silk mills in Matteawan, N. Y., by the Furnace Gas Consumer Company of Newburgh, N. Y., consists of a number of tubes made of refractory clay, which are placed end to end in the furnace behind the bridge wall in such a manner that the draught from the fire passes through them. When the fire is incandescent, the tubes are stated to absorb a large amount of heat, which is given out when fresh fuel is charged into the furnace, so that the gases therefrom are completely consumed. During tests with a 100 h.p. boiler, the heat from the tubes and from the asbestos packing between them and the boiler sufficed to generate sufficient steam to enable the boiler to be worked at full load for 12 min., while with a banked fire overnight, the pressure available in the morning has been more than double that which has been obtainable under ordinary conditions.

RAILROADS USING OIL.

THE consumption of fuel oil in the United States is steadily increasing, according to a report by David T. Day, of the United States Geological Survey, on the production of petroleum in 1910.

During that year, the quantity of fuel oil consumed amounted to 24,586,108 barrels, as compared with 19,939,394 barrels in 1909, an increase of 23.3 per cent. In the vicinity of oil fields or where cheap water-transportation can be secured, as along the Pacific coast, the cost of operating with oil is less than with coal. The use of oil, as a source of motive power for railroads, offers, aside from the use of electricity, the only certain guarantee of immunity from the hitherto generally prevalent fires along railroad rights of way. The adoption of oil as fuel on the C.M. and St. P. lines west of Butte and on the Great Northern west of Lavenworth, with a proposed extension eastward to Spokane this summer, gives great encouragement for the adoption of similar measures by the railroads of Canada on portions of their lines.

Already, the Canadian Pacific railway announces the establishment of oil-burners, effective July 1, on that portion of its line in British Columbia between Kamloops and Field. The Esquimault and Nanaimo railway, running northward from Victoria on Vancouver Island is equipped with oil burning locomotives. The economy in the use of oil along the Pacific coast is further shown by its adoption, in place of coal, on the Canadian Pacific Railway and Grand Trunk Pacific steamers. No one thing would go so far to prevent continued destruction of the magnificent forests of British Columbia as the use of oil on locommotives running through forested portions of that Province. The hardship upon the railroad companies would not be material, and, in comparison with the tremendous public interest at stake, would be infinitesimal.

POWER TRANSMISSION EQUIPMENT, N.T.R. SHOPS, TRANSCONA.

THE power transmission equipment at the N.T.R. shops, Transcona, forms not the least important feature of the arrangements made for successful and reliable operation, and in this connection, there follows a detail of the various manufacturers together with data concerning their product furnished.

The contract for the supply and installation of the leather belting was secured by D. K. McLaren, Ltd., Montreal, and the following firms supplied motors for the individual and group drives, cranes, blowers, etc. After each name is given the aggregate horsepower supplied:—Lancashire Dynamo and Motor Co., 930½ H.P.; Canadian Westinghouse Co., 907 H.P.; Allis-Chalmer-Bullock Co., 767 H.P.; Canadian General Electric Co., 335½ H.P.; General Electric Co., 193; Bruce Peebles, Ltd., 145 H.P.; Canadian Crocker Wheeler Co., 60 H.P.; Crocker Wheeler Co., 31½ H.P.; Allis Chambers Co., 31½ H.P.; Rhodes Motor Co., 10 H.P.; Electro-Dynamic Co., 7½ H.P.; Westinghouse Electric Co., 6 H.P.

PRESSURE REGULATORS.*

By S. J. Watson.

DURING the past few years a good deal of attention has been given to the use of automatic pressure regulators, and in view of the advantages which such apparatus affords, it is somewhat extraordinary that their application still remains the exception, rather than the rule, in power-station practice. In the early days of electric lighting, regulation of the supply usually rested with a man at the engine stop-valve, whose sole duty it was to keep an eye on the indicating instruments fixed in an adjacent position, and adjust the steam admission in accordance with the requirements of the moment. The generators were self-excited and there was no necessity for regulating switches or resistances. With improvements in engine-governing, regulating switches and resistances were introduced, and the duty of regulator was transferred to the switchboard attendant. This practice still prevails in the majority of power stations to-day.

Most of us are very familiar with the variations in the supply pressure, due to the inherent slowness or want of attention on the part of switchboard attendants, which are so peculiarly annoying to those responsible for the working of the departments, and irritating to the public whose good will we seek to obtain and to hold. The British Board of Trade regulations provide for the infliction of penalties if the declared pressure is varied by more than 3 per cent., or exceeded by more than 4 per cent., and it will be generally admitted that such a regulation has been necessary, if a satisfactory supply is to be given for lighting purposes. With carbon filament lamps a variation in pressure of 1 per cent. causes a variation in candlepower of about 5 per cent. Metal filament lamps do not, however, appear to be so much affected by changes in pressure, and in the future it may be possible, without disadvantage, to permit rather wider variations than are allowed by existing regulations.

In discussing the question of pressure regulators, it may be as well to eliminate any reference to automatic regulation which may be incorporated in the design of generating machinery. A compound winding may be termed an automatic regulator, and has been found quite suitable for special cases, but impracticable in its application for general supply purposes. The following remarks will, therefore, have references to regulators which may be provided as a separate piece of apparatus to the machine or machines which are to be regulated.

Separate Regulator Apparatus.

It may be noted in passing that close regulation on a generator, however provided, has a certain market price. A plain shunt wound d.c. generator is cheaper than a compound wound generator, and an alternator having poor regulating properties is, or should be, appreciably cheaper than a machine having close regulation. Such being the case, it appears not unlikely that as automatic regulating devices become still further improved and adopted as standard practice, designers may be allowed to attach less importance to regulation, and by so doing, improve the design in other directions, and at the same time effect an economy in materials and in cost. The writer does not propose to give a detailed description, or to criticize any of the various regulators which are now obtainable. There are doubtless others present who are much more closely acquainted than himself, with the

*Abstract of paper read at the I.M.E.A. Convention, Harrogate, 1912.

advantages and defects of the different types.

Automatic regulators have been designed principally with the object of maintaining a constant pressure on the busbars at the generating station, or substation, or even to produce a compounding effect, so that the busbar pressure may be automatically varied to suit the load. They may also be used to maintain a constant speed on direct current motors, which have to deal with large and frequent fluctuations of load. There exists, however, a much wider field for the application of such appliances. For instance, it is usual to connect up all feeders to a common busbar, but feeders are usually of different length, and adjustment of the pressure on each individual feeder may be necessary, owing to variations in the locality of the load, or to changes in the power factor, during different periods of the 24 hours. The ideal place for the regulator would be the consumer's premises, or even on each large consuming device connected to the system, as, however constant the pressure may be maintained at the busbars, or at the feeder points, a certain amount of disturbance to the pressure will occur on the distributing system, through the switching on and off of large individual appliances.

Regulation of Prime Mover Speed.

It is, perhaps, well to bear in mind the fact that, although voltage regulation is of the greatest importance in its relation to a direct current supply, both for lighting and power, and also for alternating current lighting, the development during the past ten years of alternating current motors for power purposes necessitates a constant motor speed for many industries, and this can only be obtained by maintaining a constant speed on the prime movers. Where the fluctuations of load are large, it may be necessary to apply the principle of the pressure regulator to the governor of the engine or turbine, so as to ensure not only a constant voltage for lighting, but also an absolutely constant frequency for power. Probably the best regulator for a direct current supply system is a storage battery of large capacity, with an automatic booster or regulating switch controlled by the busbar pressure. In addition to acting as a regulator, the battery would be found exceedingly useful at the time of a breakdown or other emergency.

Requirements of an Automatic Regulator

The principle requirement of an automatic regulating device is, of course, that it should be at all times, and under all conditions, completely automatic in its action. Unfortunately, few automatic devices are free from trouble in this direction, and the failure of a pressure regulator to fulfil its proper functions, may lead to very serious consequences. I venture to think that the possibility of a failure to act properly has been, and still is, the principal cause of their limited application to power station work. It is, however, usually possible to provide an independent device, to ensure that the regulator will be cut out of use if a certain range of regulation is exceeded.

The majority of the instruments used for the purpose of controlling the pressure of supply, consist, either of a movable iron core, inserted in a shunt coil, or of a movable shunt coil, which can rotate between the poles of a permanent magnet, the shunt coils in both cases being excited from the busbars. If the busbar pressure falls, the movement of the core or the shunt coil is in one direction, and if the busbar pressure rises, the movement is in the other direction. With ordinary changes of pressure, the movement produced and the power exerted is quite small; it is, therefore, necessary to magnify the movement or to use relays in order to obtain a sufficient range of regulation, and the mechanical power required to operate an auxiliary regulating device.

By means of the auxiliary device, which may consist of a small motor or solenoids, regulation is obtained by: (1) moving the switch which varies the resistance in circuit with the field-winding of the generator; (2) varying the field of a small, separate exciter supplying the field of the generator; or (3) diverting more or less of the field current of the generator. When a number of generators are run in parallel, a regulator may be used, controlling them all, in which case any variation in load is distributed equally over the entire plant: or with one generator only, which will then deal with the fluctuations and allow the other plant to run at constant load.

Regulator Features.

Regulators are usually provided with hand adjustment to enable the busbar pressure to be varied, when necessary, to suit the load conditions. Quickness of operation and closeness of control must always be special features in automatic regulating devices, particularly when a mixed system, say, for light, power, tramways and railways is supplied from a common busbar; but for lighting purposes only, or for a system supplying light and motors of moderate size, where the load will vary in comparatively small increments and over an appreciable period of time extreme sensitiveness in the instrument is not so essential. A variation in pressure of 1½ per cent. up or down over a period, say, of 20 seconds, would in such a case, give almost as good results in practice as absolutely instantaneous operation, but where lighting is supplied for general purposes from a power main dealing with a large and fluctuating load, or from a railway supply, a similar regulator would be almost useless.

The amount which one would be justified in expending on such devices must to some extent, depend on the limits within which the voltage is to be controlled and also the length of time which can be allowed in order to complete a cycle of operations. The narrower these limits the more sensitive and carefully designed must be the apparatus. It is difficult to express the value between a system where the pressure regulation is good and where it is bad; but that it must have a very real value from the user's point of view is undoubted. By installing automatic pressure regulators, the supply undertaking not only improves the service, but is also able to effect a more tangible saving, as the amount of attention required by the switchboard operator is appreciably reduced.

OIL FUEL.

At a recent meeting of the American Society of Mechanical Engineers in San Francisco, the subject of oil burning was discussed very fully, ten papers being read upon the subject and some twenty engineers entering into the discussion. It is interesting to note the great stress laid upon the matter of reducing the excess of air to a minimum. In general, any burner will atomise the oil if sufficient steam is applied to it. On the basis of an equivalent evaporation of 15 pounds of water per pound of oil, steam for atomising equal to 5 per cent. of that generated would be equivalent to $15 \times 0.05 = 0.75$ lb. of steam per pound of oil fired, and similarly for other percentages.

In the tests made by the United States Naval Liquid Fuel Board in 1904 the steam required for atomising varied from 1.75 per cent. to 10.81 per cent. of the total generated. In these tests a large number of different burners were used. Average good practice seems to be in the neighborhood of 3.5 per cent. to 4 per cent. for atomising, although the best practice ranges from 1.5 per cent. to 3 per cent. At the Redondo plant in California the average steam for atomising in seven tests was 2.15 per cent. of the total generated. It should be said that the steam used for this purpose will vary greatly with the same burner.

BOILER EXPLOSIONS IN THE UNITED STATES.

THE current issue of The Locomotive calls attention to the statistics concerning boiler explosions during 1911. Great care has been exercised in the compilation of the chronologically arranged lists, upon which the appended summary is based, and it is their belief that they have accounted for by far the greater number of boiler accidents which have taken place in the United States in the past year.

SUMMARY OF BOILER EXPLOSIONS FOR 1911.

Month.	No. of Explosions	Persons Killed	Persons Inj'd	Total of Killed and Inj'd
January	76	22	43	65
February	44	31	52	83
March	39	27	38	65
April	39	14	22	36
May	43	18	39	57
June	31	30	17	47
July	42	18	34	52
August	32	13	29	42
September	29	7	20	27
October	48	14	53	67
November	39	11	35	46
December	37	17	34	51
Totals	499	222	416	638

SMOKE PREVENTION RESULTS.

A CONSIDERABLE improvement has taken place in the atmosphere of Glasgow during the past two years, and this is attributed principally to the new methods which have been introduced for the consumption of coal. The Sanitary Department report a great decrease in the number of prosecutions instituted in connection with the production of black smoke. Of the large number of chimneys systematically watched by the Department, 46½ per cent. are now clear of smoke and 27½ per cent. emit an amount so small as to be far below the line of excess. There are still a number of intermittent offenders, but there are practically none which are persistent "smokers." About 10 per cent. of the steam boilers in the city have been increased in power, while at the same time their tendency to cause smoke has been reduced. Thirteen per cent. of the firms have installed mechanical stokers and 18 per cent. have fitted smoke prevention apparatus. In plants used for manufacturing purposes, 33 per cent. of those formerly fired by coal are now fired by gas.

TUBE RUPTURES.

TUBE ruptures in watertube boilers, says the Fidelity & Casualty Co. Bulletin, causing serious personal injuries or loss of life, and entailing considerable property damage occur all too frequently. Such ruptures are due either to material, originally defective, or which subsequently became so through subjection to continual heat; that became defective by pitting or corrosion, or weakened by overheating, due to low water or to the forcing of the boiler too far beyond its rated capacity.

When the rupture occurs, the fireman has to suffer, and frequently a single tube may allow all of the water to escape with the result that the entire boiler is damaged beyond repair. Tubes in watertube boilers should be carefully inspected and thoroughly hammer-tested to determine their condition and whenever there is reason to believe that the material has lost its ductility or is otherwise defective, the tube should be replaced by a new one.

CENTRAL RAILWAY CLUB OUTING.

THE fifth annual outing of the Central Railway and Engineering Club of Canada, took place on Saturday, June 22nd last, when about 150 members left Toronto by special train for the little town of Erin, Ont. Favored by magnificent weather, the excursion proved most enjoyable to all present. The train certainly broke no records on the outward journey, so that everyone was in fine shape for dinner by the time Erin was reached. In the afternoon a good programme of sports was carried out in the Stanley Park, a picturesque pleasure ground near the station. The chief item was a baseball match between teams representing the Mechanics and the Pedlars, for a silver challenge cup. The Pedlars won (8-6) thus reversing last year's result. Quoit matches, foot races, sculling matches on the lake and other events completed a well-contested programme, at the conclusion of which handsome prizes were distributed to the lucky winners. A band was in attendance and enlivened the proceedings with the latest airs.

STAY BOLT THREADS.

ACCORDING to inquires made by the "**American Machinist**" among locomotive builders, it is found that in nearly all cases stay-bolts for locomotive boilers are being made with the Whitworth thread. This is done for two reasons:— Specifications for locomotives for foreign countries always mentioned Whitworth threads, and boiler makers fell into the habit of making their taps and dies with rounded points, so that they were practically getting Whitworth conditions. Even with the United States standard thread the stay-bolt tap is very apt to become rounded on the top, as the boiler sheets are often quite hard.

SAFETY VALVES.

AT the recent American Railway Master Mechanics' Association Convention, the Committee on Saftey Valves, of which Mr. W. J. Tollerton, assistant general superintendent of motive power, Chicago, Rock Island & Pacific Railway, was chairman, presented a formula for the diameter of safety valves as follows:

Valves Having 45-Degree Seat.

D=The total of the actual diameters of the inner edge of the seats of valves required.

H=Total heating surface of boiler in sq. ft. (Superheating surface not to be included.)

L=Vertical lift of valve in inches.

P=Absolute boiler pressure in lbs. per sq. in.

$$D = .036 \times \frac{H}{L \times P}$$

The committee further reported that the only accurate method of determining the capacity of safety valves is by actual test in a testing plant; the safety valves being fully equipped with springs, as in actual road service. In order that it should be positively known that safety valves will prevent undue rise in pressure under extreme conditions, they should be subjected to a road test.

Nickel valves and valve seats were referred to as desirable, but are expensive as to first cost and renewals, and the committee recommended the continuance of the use of bronze alloys. The practice of screwing down the safety valves during a hydrostatic test was condemned. One safety valve should be removed and replaced with a special valve, and the other valve or valves should be removed and replaced with caps or plugs during test.

C.P.R. ELECTRIFICATION.

The electrification of the Rossland division of the Canadian Pacific Railway in British Columbia is being pushed forward to determine the applicability of such a course under the heavy conditions to be encountered. The section to be electrified runs from Rossland to Castlegar Junction. The length of the Rossland division is 29.3 miles, which, with sidings and yard trackage mounts up to a total trackage of 43 miles. The motive power installation will consist of four 70 to 80-ton electric locomotives; power being obtained from the West Kootenay Power and Light Company at probably 60,000 volts. This will be utilized through motor generator sets in sub-stations located either at Trail or Smelter Junction. Systems using alternating current at 6,600 volts and direct current at 2,400 volts are being proposed.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. V. JULY, 1912 No. 7

LIGHT AND POWER IN TORONTO.

CITIZENS of Toronto have been passing through experiences recently, the reverse of pleasant. Lightning pranks on the transmission lines of the Toronto Electric Light Co. forced on several occasions stalling of the street cars, more or less interference with manufacturing operation and indeterminable inconvenience in the domestic and personal spheres. Advantage of course has been taken, as always happens, of "kicking a man when he is down and trying to keep him there," to boost a competitor, and at this time free air is being given the Hydro-Electric to aeroplane its wonderful attributes into the dizzy heights of public favor. We sincerely hope that the mad rush to get out of the one concern and into the other does not involve the procedure of "slipping from the frying pan into the fire."

What really is of importance, and gives occasion for surprise, is the complacent reliance which both the Toronto Electric and Hydro Electric Companies put upon their power supply and its transmission equipment to this important industrial and residential centre. The requirements of present day civilization are of more consequence than the administrators of our prominent public utility corporations apparently realize. Their attitude is to get all they can from a long-suffering public and give as little in return as possible. So much so is this in evidence that the only reasons which can be adduced are those of a broken public spirit in sublimely submissive resignation, coupled with the impressive display of infallibility which long years of selfish achievement appears to breed in the natures and councils of civic and utility corporations.

The incidents referred to have directed timely attention to localized steam power equipments, a phase of electric generation for power and light purposes, which has been somewhat under the weather since hydro-electric power blossomed into being. The Toronto Electric Light Co. need not worry itself about a husky, yet bolstered-up competitor, but should set its house in order by putting itself on an almost impregnable footing through the installation of a thoroughly modern steam or gas power plant whose capacity for the generation of electricity would be practically the equivalent of its hydro.

C. A. S. E. CONVENTION AT BELLEVILLE.

BELLEVILLE is this year the Mecca of stationary engineers, at least so far as the province of Ontario is concerned, and from what we have been able to learn of the plans of the executive and the commissions of the various delegates, decidedly important and forward steps will be taken in the direction of greater activity in the propagation of the Association's work. It is becoming increasingly realized that the record of this in the past has not kept pace with "Canada's growing time," and if the influence that such an association is capable of exerting, not only on behalf of its members, but relative to the general welfare, is to be other than negative, no time should be lost in having it actively displayed. The tendency to claim overmuch pride in what little has been achieved is apt to dull the sense of perception and minimize the importance of what still remains to be done.

Dissatisfaction with the labors of the executive has been given expression to in the columns of this journal, as has also been the apathy of the individual lodges and their members, and while we may not seek to discriminate, there is little doubt that, taken as a whole, more could easily have been accomplished. The question that naturally arises is—what will constitute a remedy, whole or part? On this point many suggestions have been put forward from time to time, and of these, two only will be referred to here. It has been proposed that a paid permanent organizing secretary be appointed whose duties would be to keep in close personal touch with the various lodges by regular visitation. Such a man, tactful, intelligent, impressive, diligent and progressive, would achieve more in twelve months' time for the Association than its present constitution has done in the past 10 years. Again, it has been urged, and not without a considerable show of reason, that a larger percentage of new blood in the executive would be conducive to a relative percentage increase in new blood membership, besides arousing greater enthusiasm among the existing brethren. The tendency with all of us is to dwell on our past achievements, real or otherwise, and as a consequence, progress is barred to attainment, beside which our work would appear insignificant. The Canadian Association of Stationary Engineers has a place to fill in the upbuilding of this Dominion, yet, in very name, it has failed to fulfill that obligation. In the ranks of the association are men capable alike on the platform, with the pen and at the throttle; men who should not only be given a chance, but who should be commanded and elected by their fellows to organize the commendable work which the C. A. S. E. has taken upon itself to perform, and who will actively give of their leisure to secure large accomplishment.

Our wishes are that the coming convention of the Canadian Association of Stationary Engineers be that of the most successful function of its kind yet held, bearing on its conclusion, evidence not only of Belleville's hospitality, but that also of invigorated efforts in its own professional sphere.

GAS AND OIL ENGINE PROGRESS

A record of principles of design, construction and achievement in a rapidly developing sphere of power generation.

BITUMINOUS COAL PRODUCERS FOR POWER.

By C. M. Garland, Camden, N.J.

IN the development of the power producer for the gasification of fuels containing above 12 per cent. volatile matter, the manufacturers at an early date divided themselves on the question of the method of handling this troublesome constituent and proceeded with their developments along two diverging lines. In one, they sought to convert the condensible combustible constituent of the volatile matter into fixed combustible gases by drawing this product through either the whole or part of the incandescent fuel remaining after volatilization; in the other to separate the condensible portion from the permanent gases after these had left the generating chamber. The former group accordingly turned their energies to the development of down-draft and double-zone arrangements, while the latter bent their efforts toward the production of efficient up-draft generators and tar-handling apparatus. It has been the fortune of the writer to observe the operation of a number of plants of the latter type and to analyze the results of the operation of others. The object of this paper is to present some of the data accumulated, although necessarily more or less fragmentary in character.

Description of Apparatus.

The plants are of two general types—suction and pressure, while the apparatus is essentially similar in each, varying principally in size and general arrangement. Fig. 1 shows a vertical section through the producer, scrubber and water-sealed gas main which is characteristic of the arrangement of all later plants up to about 1,000 h.p. capacity. The pressure plant differs from the suction plant by the addition of a fan type blower, frequently installed in duplicate, and a regulating holder. This latter in the earlier plants served as a large storage reservoir with capacity sufficient to keep the engines operating from 3 to 10 minutes in cases of emergency. It was also thought that this large capacity tended to insure greater uniformity in the composition of the gas supplied to the engines, so that the holders were placed in series with the engine and scrubbers. In more recent plants the size of the holder has been greatly reduced and in most cases floats on the line so that the gases do not pass through this piece of apparatus. This change has been brought about partly by the fact that a large storage capacity is not required and in many places is undesirable. Also the mixing effect of the gases in the holder has proved a fallacy.

From Fig. 1 it will be noted that the producer A is of the water-sealed type with central blast B and superimposed vaporizer C. The gases pass direct from the producer to the scrubber D, which is provided with a verticle baffle E from the scrubber to the water-sealed main F, and from this to the tar extractor G. This latter piece of apparatus is of the centrifugal type and is illustrated in Fig. 2. Referring to Fig. 2, the gas enters at A and meets a stream of water at B. The mixture flows upon the rotating vanes C and is discharged into the stationary vanes D. The water and a portion of the tar is thrown out against the casing E and follows this around to the drain F which discharges into the seal pit G. The gas leaving the stationary vanes D re-enters the rotating vanes H on the opposite side of the disk I. It here meets a stream of water from the nozzle J moving in the direction opposite to the gas which removes the remaining tar. The gas leaves at K.

The extractors are usually designed to deliver the gas under a low pressure and are built in more than one stage for the larger powers. A portion of the steam generated in the superimposed vaporizer C in Fig. 1 is used to saturate the blast. The amount supplied is indicated by the temperature shown on the thermometer H, which extends into the blast pipe I. The steam pressure on the vaporizer is maintained constant by the back pressure valve J, while the air pressure on the main K is also constant. The valve L, is therefore used to vary the amount of steam delivered to the blast. The butterfly valve M connects with the holder and regulates the amount of blast delivered to the producer. Changes in the position of this valve do not affect the relative proportions of air and steam. In more recent plants, a thermostat located in the blast pipe operates a throttle valve in the steam line from the vaporizer in order to maintain a constant temperature of the blast.

The fuel is fed to the producer by the hand-operated centrifugal charging device N, which insures a very even distribution of fuel. This consists of the hopper provided with the ribbed charging bell O, which is rigidly mounted on the shaft P and held against its seat by the counterweight Q. When the fuel is charged, the bell is lowered by the arm R and at the same time rotated by the arm S. Both arms are hand-operated. After the fuel is charged, the counterweight Q causes the bell O to seat. A sliding cover closes the top of the hopper which prevents the escape of gas while dropping a charge of fuel.

Thermal Efficiency of the Producer.

The efficiency depends to a certain extent upon the amount of volatile matter contained in the fuel. For fuels containing as high as 30 to 50 per cent. of volatile matter, the thermal efficiency based on the higher heating value of the gas is about 66 per cent., while the efficiency based on the effective heating value of the gas is ordinarily 5 per cent. lower than this, or 62.7 per cent. Where the volatile matter does not exceed 20 per cent. the efficiency is somewhat higher, and 70 per cent. based on the higher heating value of the gas is an average figure. The lower value is approximately 66.5 per cent. In plants of the present type, however, thermal efficiency is not necessarily of paramount importance, for more often it is a question of the adaptability of the producer to a given fuel or to several fuels and of continuity and reliability of operation.

Composition of the Gas.

The composition of the gas and the heating value are comparatively uniform where proper attention is given to

*Abstract of paper read recently before the American Society of Mechanical Engineers.

the operation of the producers. The average higher heating value of the gas was 144.1 b.t.u. per cu. ft. at 62 deg. Fahr. and 30 in. mercury pressure. The average lower heating value was approximately 136 b.t.u. under the same conditions of pressure and temperature. For fuels containing greater percentages of volatile matter there is a tendency toward an increase in the calorific value of the gas due to the increase in hydrocarbons. With the lignites, for example, the higher heating value of the gas may average as much as 155 b.t.u. per cu. ft.

Volume of Gas Generated.

The volume of gas generated per pound of coal depends upon the composition of the coal and the condition of the fuel bed. In the seven-day test, the volume of the standard gas generated per pound of run of mine Pocahontas coal was approximately 71.5 cu. ft. For lignite, the volume of standard gas varies between 36 and 40 cu. ft. per lb.

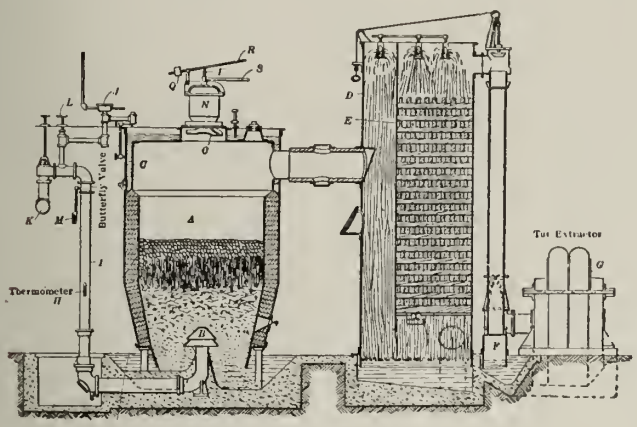


Fig. 1—Bituminous coal producers for power.

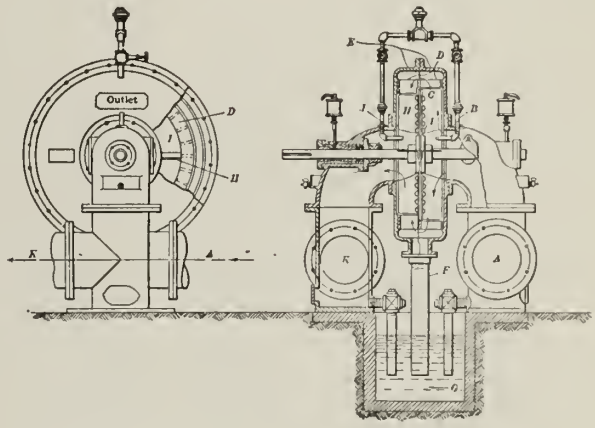


Fig. 2—Bituminous coal producers for power.

Cleanliness of the Gas.

A large number of tests have been made on the cleanliness of the gas delivered by the tar extractors in a number of plants.

From these it was found that the amount of solid matter in the gas has been reduced to a very small quantity and averages 0.0206 grains per cu. ft. of standard gas. The efficiency of the tar extractor was taken as the ratio of the weight of solid matter in the gas leaving the extractor to the weight of solid matter in the gas entering the extractor, multiplied by 100.

From the results, it is apparent that the average weight of solid matter per cubic foot of standard gas is not sufficient to cause trouble in engines of ordinarily good design. Experience seems to indicate that with 0.03 grains of solid matter per cu. ft. in the gas, the engine valves require cleaning once in two or three weeks. There is no trouble from this source in plants that are properly operated and the cleaning of the valves would not be considered a hardship.

Handling of the Tar.

In the earlier plants, considerable difficulty was experienced by the tar accumulating in the scrubbers and pipe lines, which caused frequent shutdowns. In almost every case, this trouble was due to lack of experience on the part of the builders in designing these parts, and to operators who failed to take proper precaution and profit by their first troubles. At the present time and for the more modern plants, it can be safely said that trouble from this cause has almost entirely ceased. The water-sealed gas main has solved the piping difficulty, while refinement in the design of the other parts and close attention to detail has accomplished the same effect for these.

In so far as the yield of tar is concerned, there are but three objections that can be urged:

A—Loss in efficiency of the plant due to the removal of a combustible constituent from the fuel.

B—The expenditure of power in the driving of the tar extractor for the removal of this constituent.

C—Difficulties in the disposal of the constituent.

Taking it for granted that the tar in every instance can be disposed of satisfactorily, as it can be, the answer to these objections is that it is entirely a question of economy and if it does not pay to handle this element then bituminous coal is either not the fuel to use or a producer plant is not the kind suitable to the conditions. The magnitude of the above items is fairly well known. The loss in thermal efficiency (a) varies from 12 per cent. for fuels containing from 15 to 20 per cent. volatile matter to 17 per cent, for fuels containing above or near 30 per cent. of volatile matter. The amount of power (b) required to drive the tar extractor depends upon the nature of the tar produced. With lignites, for example, which produce a thin yellowish tar resembling very nearly a heavy oil, the power required is at least 25 per cent. less than the amount required for bituminous coals. For the latter, this power varies from 5 per cent. of the power in a plant of 100 b.h.p. to about 3.5 per cent. for a plant of 1,000 b.h.p., and it is believed that this figure will be reduced almost one-half in the near future.

As to the difficulties in the disposal of the tar (c), there is in some instances a ready market for the tar product so that this may be disposed of to advantage. In other cases where boilers are in service, it can be burned without difficulty under these boilers. The usual method of handling the tar is to place the extractor over a pit containing water into which the mixture of tar and water from the extractor is discharged. The pit is arranged so that the tar may be skimmed from this into a barrel or receiver. Where a receiver is used, it is provided with an air tight cover, and when the receiver is filled, the cover is put in place and either steam or air under pressure placed above the tar, which forces it through piping to the point of disposal. Where the tar is thick and heavy, it is necessary to provide the receiver with a steam coil to keep the tar in a fluid condition.

St. John, N.B.—At the meeting of the Canadian Association of Stationary Engineers held recently, the election of officers took place. The reports showed a large increase in membership and that the association was in a flourishing condition considering that it has been in existence only one year. The following are the officers elected: President, John A. Lobb; vice-president, Frederick Latham; recording-secretary, E. W. Barry; treasurer, Frederick Watson; financial secretary, Ed. Duff; conductor, George A. Elliott; doorkeeper, W. J. McHarg; trustees, John Smith, J. Daley and Samuel T. Seeds.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

ROTARY CONVERTER CONTROL.

IT is reported in the columns of Electrical Engineering that a 500-kilowatt rotary converter is to be erected in a sub-station of the Detroit Edison Company, controlled entirely through its alternating current feeders from a substation a mile distant. A daily inspection will be made, but otherwise no attention, it is hoped, will be required, all operations of starting, closing the field circuit, direct-current switches, etc., being done by the operator in the distant station where are situated the starting compensators. By putting the handle of the starting compensator in the starting position, a reduced voltage is applied over the 4,600-volt feeder to the terminals of the rotary, which, as soon as the correct speed is reached, will have its field circuit closed by a centrifugal switch, the ammeters at the controlling station then giving a reduced reading as the rotary falls into step. The starting compensator can then be thrown into full running position. A differential pressure relay arranged between the direct-current side of the converter and the bus system will control the main direct-current switch, closing this as soon as the converter pressure rises to that of the system, regardless of what the latter may be at the time. The load on the converter can then be adjusted to the value desired.

RELIABILITY AND CONTINUITY OF ELECTRICAL SUPPLY.

A PAPER entitled "Means for Security Reliability and Maintaining Continuity of Supply" was recently read before the Incorporated Municipal Association in England, by Mr. Frank Ayton, of Ipswitch. He remarked that in most stations it was necessary to keep one or more boilers banked during a considerable portion of each 24 hours simply for use on the "peak," or in case of an unexpected fog or thunderstorm. It was often necesary that these boilers should be fired up and turned on to the main range very quickly, and it followed that the less the drop in steam pressure which occurred between the time the boiler was taken out of commission and the time when it was wanted, the less time would be required to get it steaming again. At Ipswich, where large marine boilers of the dry-back type were installed, it was found that a boiler taken off the range with fires banked at 9.0 or 10.0 p.m. would show only about 80-lb. pressure on the gauge early next afternoon when the time came to restart it. Experiments, directed to reducing the drop in pressure, showed that by making the damper fit its frame so that it was practically air-tight—a feature which most ordinary dampers did not possess—and by taking great care to keep the brick settings also air-tight, the drop in pressure was reduced to only 10 lb. at the most during the banking hours, and that merely opening the damper and turning over the fires sufficed to bring the boiler up to pressure in about 20 minutes. Not only was there the saving of time, but there was also quite an appreciable saving in the amount of coal required to raise the pressure.

The Distribution System.

He supposed it would be generally conceded that the majority of the causes responsible for interruptions to supply were connected with the distribution system. This seemed to be the weakest link in the chain, although modern systems were well ahead in the matter of trustworthiness compared with those of only a few years ago. On direct-current systems some engineers preferred to connect up solid, or without the intervention of any safety devices such as automatic circuit-breakers or fuses, right away from the switchboard bus-bars to the consumers' cut-outs. Of course, fuses on the mains to isolate one feeder district from another were required by the Board of Trade regulations. On the other hand, there were some engineers who preferred to protect each feeder at the switchboard by either a fuse or an automatic circuit-breaker. Some went further and inserted fuses in the connections to the distributors themselves, placed in the feeder boxes or pillars, while others went further still and fused each individual distributor at every point where it connected to adjacent distributors. Touching his own undertaking, there were no protective devices between the bus-bars and the consumers' cut-outs, and his experience had led him to think that such an arrangement, from the point of view of maintaining continuity of supply, was not an altogether desirable one, especially in dealing with a three-wire system. Anything in the nature of a dead short on the mains, as a rule, meant a complete shut down, and, in his opinion, feeders should be arranged, by means of time-limit maximum circuit-breakers or fuses, to free themselves from the bus-bars in case of any serious fault.

MOTOR WAGON WITH HYDRAULIC TRANSMISSION.

A MOTOR wagon weighing five tons, fitted with a system of variable hydraulic transmission, having as its basis a pump invented by Dr. Hele-Shaw, was the subject of a recent demonstration by Messrs. Campayne, Limited, 64 Victoria street, S.W., London, England. In this vehicle, the petrol engine is coupled direct to the pump, and the two motors, which are incorporated with the driving wheels, are actuated by oil which is forced through them and returns to the pump in a closed circuit. The pipes which convey the oil converge on a universal joint about the middle of the chassis and serve as radius and torque rods, and there is no flywheel, clutch, change-speed gear, or differential.

Operating Features.

Alterations in speed are effected by altering the stroke of the pump, which is of the rotary plunger type. It consists of a cylinder body, with seven pistons, rotating on a fixed spindle in which are cut the induction and eduction ports. The pistons carry gudgeon pins having slippers which work in an annular groove on the inside of a revolving drum. The gudgeon pin centres are thus constrained to follow a circular path, and if this path is so set that its

centre coincides with the centre of the fixed spindle no radial motion is communicated to the pistons; but if the centre is moved to one side or the other, liquid is pumped in and out, the rate of delivery varying with the amount of eccentricity and the direction according as the path is moved to the right or the left. The revolving drum or floating guide ring, can be adjusted to any desired position, but rotates freely on ball or roller bearings which are carried on guide blocks sliding in grooves in the main casing of the pump and connected to the stroke-varying spindle.

When the cylinder body is revolved, the floating ring revolves with it, the resistance of the slippers being greater than that of the bearings. In the central position, the slippers make no movement in their grooves, and in any other position, move too and fro only to an extent directly proportional to the stroke. A great saving of power is effected in this way, and the fact that the drum revolves confers another advantage. If the slippers moved around a groove in a fixed case, that case would have to be retained full or partly full of oil for the sake of the lubrication, and the churning up of the oil would mean waste of power; but because it rotates with the cylinder body and slippers, it can be kept full of oil by centrifugal force and yet no churning occurs.

Motor Features.

The motors also present several novel features, one of these being the use of a cam which forms a track for rollers on the piston crosshead. This cam enables a large lap to be used in the valve action and reduces to a minimum the loss by slip or leakage in passing from the suction to the pressure side; it further enables the motor to work under its full load and at high speed without injurious vibration and without causing serious fluctuations on the pressure gauge, even at pressures up to 1,500 or 2,000 lbs. per square inch. In dynamometer tests, this motor has shown an efficiency exceeding 95 per cent., while in the motor wagon, which is the first of its kind to be constructed and is therefore largely experimental, the overall transmission efficiency at the road wheels exceeds over 76 per cent. at eight miles an hour and 72 per cent. at 12 miles an hour, its maximum legal speed. Running at this latter speed on the level, the engine makes about 600 r.p.m., and the oil pressure is about 200 lbs. per square inch. Any lower speed can be obtained simply by reducing the stroke of the pump, and the same action serves to brake the vehicle on a decline; rapid acceleration and retardation being effected with remarkable smoothness and absence of shock.

In order to maintain speed on ascending a steep hill, the engine is accelerated and the pressure may rise to 1,200 or 1,500 lbs. per square inch; 2,000 lbs. being the limit for which the apparatus is designed. Many other applications of this system of hydraulic transmission can be suggested, such as lifts and hoists, cranes and sheer-legs, machine tools, hydraulic presses, etc.

STEAM V. ELECTRICITY FOR RAILWAY TRACTION.

JUDGING from the opinions of railway men so far expressed, it appears safe to say they are practically unanimous that for frequent uniform suburban services electricity has already proved its superiority over steam for railway traction. Mr. E. B. Maitland, in a discussion at a graduates' meeting of the Institute of Mechanical Engineers, pointed out that "for services where there are many miles between successive stops and where a considerable time elapses between the passage of successive trains, the use of the steam locomotive permits of advantages which are unattainable with any electrical system of traction. It is obvious that for long lengths of track, both the first cost and maintenance charges for electricity will be considerably greater than those for steam: because not only are there the cost of the transmission lines, examination and repair of same, but also those of sub-stations and auxiliary machinery. Again, as there are far fewer trains than on the previously mentioned suburban services, the stand-by charges at power and sub-stations is proportionately increased.

The greatest point in favor of the steam locomotive with regard to ease of manipulation and traffic working, is, perhaps, its independence and freedom from sectional break-downs. It is also probable that before the electrification of our main lines could take place, the whole system of their commercial management would have to be changed, as they could only be run with anything like true economy by using district power stations, each supplying all the lines within a certain radius, so that what are at present separate railways would receive their current supply from the same nuclei. For short branch lines where there is light traffic, there seems little doubt that the self-contained steam coach has come to stay. For main lines, the whole question seems to be one of coal consumption; and with the modern steam locomotive, which the author believes is by no means incapable of further improvement, especially when superheating shall have been universally adopted with its attendant saving in coal and boiler maintenance, it will be very hard to prove its inferiority in this respect."

THE TESLA TURBINE.

IN describing the steam turbine designed by Nikola Tesla, a writer in the columns of a German contemporary, directs attention to the fact that there is little likelihood of its competing seriously with the bladed turbine, as the theoretical efficiency cannot exceed 50 per cent., which is far below that of a bladed wheel turbine. The turbine consists merely of a number of discs spaced close together, which are driven round by the friction of the steam rushing through tangentially between the discs. Large sizes running condensing, it is maintained, are quite out of the question in consequence of the impossibility of passing the large volume of low-pressure steam out through the centres of the discs.

RECENT PATENTS.

BELOW will be found a list of patents recently issued in Canada relating to power generation, and furnished by Fetherstonhaugh & Smart, Castle Bldg., Ottawa, Canada.

140,918 — H. Ford, Detroit, Mich. — Transmission mechanisms.

140,921—Wm. Gray, Amesbury, Mass. —Governors for dynamos and means for ventilating the same.

140,087 — Thos. L. Willson, Ottawa, Ont.—Apparatus for developing power from steam. The International Marine Signal Co., Ltd.

140,105 — I. N. Hammond, Portland, Oregon — Changeable speed friction transmission mechanisms. I. B. Hammond & Heo. H. Holder.

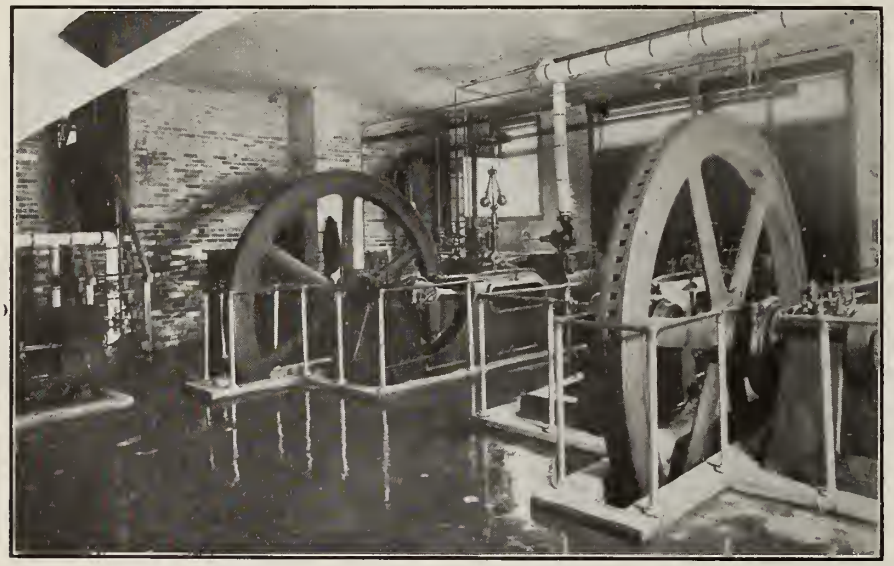
Mr. Cecil B. Smith, a prominent Canadian engineer formerly chairman of the Temiskaming and Northern Ontario Railway Commission, and later a member of the Hydro-Electric Power Commission of Ontario, died at his home, 51 Spencer avenue, on Saturday evening, June 29. About three weeks ago, while on a professional tour in the Western United States, he was taken ill at Los Angeles, California. He returned home, but physicians could do nothing to save his life, as cancer in an advanced stage had attacked his stomach and liver, and an operation would have caused instant death.

Bowring & Logan have removed their headquarters office to 322 Donald street, Winnipeg, Man., but retain their connection with the east through a sub-office at 43 Victoria street, Toronto.

REFRIGERATION DEPARTMENT

ARTIFICIAL ICE SKATING RINK.

PROFESSIONAL hockey in Toronto has not hitherto flourished to the extent it would undoubtedly have done if Dame Nature were less fickle in dispensing her favors during the winter months. So long as the local "fans" were always in a state of distressing uncertainty as to whether or not an extensive thaw would set in on the day before an important game, it was hardly to be expected that enthusiasm could be kept at a red hot heat or that schedules could be satisfactorily adhered to. Thanks to the Arena Gardens Co., of Toronto, these nerve-destroying worries are now a thing of the past! The magnificent artificial ice rink erected by the company on Mutual Street, Toronto, which it was hoped would be in use by the middle of last season, is now finally completed and equipped, and Toronto enthusiasts will in future be able each winter to get all the hockey they want, irrespective of caprices of the weather.



MACHINERY EQUIPMENT, ARTIFICIAL ICE RINK.

Equipment Features.

The building measures 280 feet long by 184 feet wide and is spanned by a steel arch roof, said to be the largest span in Canada. Seating accommodation is provided for 7,000 people; the tiers of seats being well banked up so that everybody can get an unobstructed view of the game. The skating surface measures 200 feet by 80 feet, the floor being covered with brine coils totalling 49,000 lineal feet. These coils rest upon two layers of ½-inch asphalt, below which is a 4-inch bed of cork insulation. Power for the two refrigeration units is provided by two hand-fired return tubular boilers rated at 100 h.p. each. These work at 130 pounds pressure and were built by the Goldie and McCulloch Co., Ltd., Galt. Natural draft is provided by a brick stack 80 feet high and 2 feet square inside at top.

The two refrigeration units are exactly alike and were built by the De la Vergne Machine Co., New York. Each unit consists of a horizontal double acting 50-ton ammonia compressor, cross-connected to a horizontal Corliss engine making 65 R.P.M. The steam cylinders are 19½ x 22 inches, and the compressor cylinders 13½ x 22 inches. As already mentioned, brine is employed for freezing the rink. It is made from calcium chloride and is circulated by duplicate Dean duplex 9-8½-10 steam pumps, which draw it from a large cooling tank and circulate it through the coils of the skating floor, back to tank again. The tank is fitted with two agitators, one at each end. These are belt driven at 250 R.P.M. by two 3 h.p. motors. The ammonia condenser is of the double pipe type, 12 pipes high, 6 pipes wide and 19 feet long, city water being used for cooling.

Can Ice Manufacture.

While the plant will in winter be used solely for freezing the skating rink, it is by no means idle all summer. During the warm weather it is used as a fully equipped can ice factory, the brine cooling pit being arranged to accommodate 618 cans of a capacity of 300 pounds each. The ice is made from distilled water, the exhaust from the engines being utilized for the purpose. The exhaust steam passes from the cylinder to an 8-inch header, then, after the oil has been extracted from it by an efficient separator, it is condensed in a Wheeler surface condenser, using city water which has previously done duty in the ammonia condenser. The condensing water is thus raised in temperature to about 180 Fah., and is then delivered to the boilers by two 6-4-6 horizontal duplex feed pumps. The water of condensation on leaving the Wheeler condenser gravitates to a steam-heated reboiler in order to have all air removed. After being boiled, the water enters a large storage tank, from which it passes to a double pipe cooler. When cooled, the distilled water is filtered in a charcoal filter and is then ready to be frozen. The cans in the brine tank are filled by an automatic filler which cuts off the supply when 300 pounds of the distilled water have been delivered.

The brine tank is served by an overhead traveler equipped with an air hoist for lifting two cans at once. Compressed air for this hoist is supplied by a Westinghouse 11-inch compressor located in the boiler-room. After the cans have been dipped in the hot water tank, the ice is dumped to a chute which delivers it upon the floor of an Otis-Fensom freight elevator, by which it is taken to an ice storage room on the floor above. This storage room is insulated with cork and cooled by direct expansion coils. In winter, when no can ice is made, the engines work non-condensing, part of the exhaust being used to heat the rink by direct radiation and part being turned into a Cochrane feed water heater. The building is heated on the Webster system, the returns being discharged to a storage tank by a 5-6-10 horizontal simplex vacuum pump. From the tank the returns are delivered to the heater by a motor driven centrifugal pump which is automatically controlled.

The arena of course will not be heated sufficiently to cause a mist on the ice, but it will be kept as warm as experience shows to be permissible. This is a feature which will doubtless be greatly ap-

preciated by its patrons who usually have to rely upon the excitement of a game to keep themselves warm. In the summer months the building is available for horse shows, flower shows, banquets or similar functions. The can ice plant was started three weeks ago and has now got fairly into its stride. In addition to the compressor units, the De la Vergne Machine Co. supplied the ammonia condenser, brine and ammonia coils and all the other details of the refrigerator equipment.

The promoters of the Arena Garden Co., of Toronto, are to be congratulated on their enterprise in building this fine rink, which will doubtless yield them substantial returns.

HYDRAULIC RIVETING*

By H. J. Hartley.

CONSIDERABLE diversity of opinion seems to exist regarding pressure per square inch of rivet section required for all classes of boiler work. At the present time the importance of having rivets to completely fill the holes is more fully realized and insisted upon than was the case twenty years ago. Under the old system of hand riveting, with the holes much too large for the size of rivets to be driven, doubtless much imperfect work was made. It was, and still is, a fruitful source of disaster, as rivets with loose fitting bodies, in addition to being imperfect themselves, allow undue weakness in the plates, owing to unequal and incomplete bearing surfaces. Hence, the strongest joint has been found by experiment to be that in which the area of the rivet body exceeds the net sectional area of the plate; the increased friction on the bearing surfaces and grip of the rivet heads on the plates more than compensating for the reduced plate area.

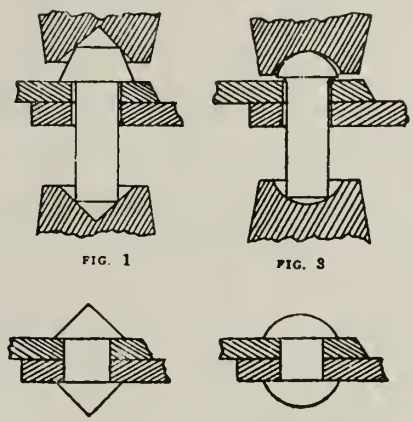
When riveted joints are being formed, the tendency is for the rivet to be upset on the end where the final head is being formed; the friction in the rivet hole resisting its flow to some extent. It is conducive to tight work to have a fillet under the head of the rivet which will, wedge-like, jam into the slightly countersunk hole; thus insuring, at least without the necessity of caulking, a watertight rivet, provided the plates composing the joint have been properly fitted and the rivet holes made fair and of proper size. The allowance, on increased sizes of rivet holes for heat expansion over the sizes of the rivets to be driven in first-class high-pressure boiler work, should not exceed the following fractional numerals, namely:—For ¾-in. rivets make hole 1-32-in larger; for ⅞-in., 1 in. and 1⅛-in. rivets make holes 3-64 in. larger; for 1¼-in., 1⅜-in. and 1½-in. rivets make holes 1-16 in. larger, and so on proportionately. All rivets should be heated to a medium cherry red at the head, and, if possible, to a dark cherry red at the points.

*Abstract of paper read recently before the American Boiler Manufacturers' Association.

Cold Rivets for Tank Work.

With regard to the pressures required for driving rivets cold in tank and stack work, I would recall some experiments made by Wm. Sellers & Co., between the compression platforms of their Emery testing machine. A number of ⅜-inch size rivets were subject to pressures between 10,000 and 60,000 pounds with the following results:

At 10,000 pounds the rivet swelled and filled the hole; at 20,000 pounds the head was well formed; at 30,000 pounds the rivet was well upset and headed; and at 40,000 pounds the metal plates surrounding the rivets began to stretch. This became more pronounced as the pressure was increased to 60,000 lbs.



Hydraulic Riveting.

From these experiments, the conclusion might be drawn that the pressure required for driving and heading cold rivets is about 150 tons—300,000 pounds per square inch of rivet section.

Rivets for High-Pressure Boilers.

A series of tests to determine pressures for driving rivets in high-pressure steam boilers was made about the same time at the Baldwin Locomotive Works, by Mr. Vauclain, with the following results:

Six sets of 9-16-inch plates were selected and prepared for the tests, each set being composed of six plates, these being drilled for rivets varying in size by one-eight, from ⅝-inch to 1¼ inches in diameter. In the first set, the ⅝-inch rivets were driven with a pressure of 25 tons; in the second set, the ¾-inch rivets were driven with a pressure of 33 tons; in the third set, the ⅞-inch rivets were driven with a pressure of 50 tons; in the fourth set, the 1-inch rivets were driven with a pressure of 66 tons; in the fifth set, the 1⅛-inch rivets were driven with a pressure of 75 tons; and in the sixth set, the 1¼-inch rivets were driven with a pressure of 100 tons.

The specimens when cut in half longitudinally through the rivet showed that where a pressure of 33 tons had been applied, the metal under and around the heads of the ⅝-inch rivets was indented or compressed. When 50 tons on both the ⅝-inch and ¾-inch had been applied, the same effect was noted, and so on up to 100 tons pressure.

In a second test similarly conducted, the rivet holes were punched instead of drilled; the only difference in the result being that the plates showed no indentation and the holes were all filled. The conclusion was that the suitable static pressure for ⅝-inch rivets is 25 tons; for ¾-inch rivets, 33 tons; for ⅞-inch rivets, 50 tons; for 1-inch rivets, 66 tons; for 1⅛-inch rivets, 75 tons, and for 1¼-inch rivets, 100 tons. Converted into pressure per square inch of rivet section, the figures in even pounds, would be approximately as follows:

Diameter of Rivets.	Pressure per Square Inch in Pounds.
⅝ inch	163,000
¾ inch	149,000
⅞ inch	166,200
1 inch	168,000
1⅛ inches	151,000
1¼ inches	163,000
Average	160,000

Example—Static pressure, 25 tons= 50,000 pounds, divided by area of ⅝-inch rivet=.3680=162,952 pounds pressure per square inch of rivet section. The average of the above pressures per square inch of rivet section is 160,000 pounds, which may be used in calculating the necessary pressures for rivets of other sizes. An experiment was also made in cold riveting, thus: A pair of plates were punched for ¾-inch rivets, which were driven into the holes with the same range of pressure, but it was found that the lower pressures were not sufficient to form the head, whereas the higher ones indented the plates. The writer has been working under the foregoing described conditions with the same riveting plant for about twenty years, doing all classes of steam-boiler work, varying in thickness of plate from ⅜ inch to 1¾ inches, and in rivet diameter from ⅝ inch to 1½ inches, with perfect success.

Terminal Impact of Ram.

There exists a condition, however, connected with hydraulic riveting, that is especially favorable to rivet compression and the making of tight work, which is generally not known or realized. It is due to an increased pressure at the terminal stroke of the ram over the initial stroke, amounting by experiment to

be conditionally as high as 60 per cent. In other words, a static pressure of 1,200 pounds per square inch in an accummulator has shown on the gauge at the end of the stroke a momentary impact of 2.000 pounds per square inch. It will be understood that this increased terminal pressure is due to the surge of the accummulator on its sudden arrest at the end of the stroke and at the time when the rivet has become cooled from contact with the water-cooled dies and plates. Too much value cannot be given to this terminal pressure as a climax to perfection in hydraulic riveting; the effect being about the same as that of a second pressure on the rivet after partially cooling. This advantage is ever there and costs nothing to obtain, being altogether unlike the extra labor required on hand and pneumatic riveting to accomplish the same object—tightness, by having to partly drive a rivet and shift to the next in order to allow the first to cool; partly drive the second, shift back to the first and finish it, then go again to the last left unfinished, and so on throughout.

In order, however, to obtain the full value of the terminal pressure, it is necessary for the operator to exercise some skill in admitting the initial pressure to the ram. This is done by opening the valve slowly and sufficiently until the hot rivet has been well upset into the hole, after which the full pressure is applied. This will have the effect of accelerating the descending momentum of the accummulator, thereby causing a suddenly increased pressure on the rivet at the moment of its impact and the rebound, due to cushioning on account of more or less air in the water. This is more apparent with accummulators having small areas of pistons.

Shapes of Rivet Heads.

The accompanying illustrations will show the shapes of the rivet-beads generally in use by most boiler manufacturers.

Fig. 1 shows the shape of rivet-head mostly used by manufacturers. It also shows a rivet with pan-shaped head, ready to be driven with cone-shaped dies. The rivet being hot and the initial pressure bearing on the head and point, it necessarily follows that the rivet must flow into the dies before it gets bearing sufficient to squeeze it into the hole; the initial pressure being utilized in filling the dies.

Fig. 2 represents the shape of the rivet-heads after being driven.

Fig. 3 represents a rivet with round-shaped head, having fillet under head, heated and ready to be driven. It will be noticed that the dies on head and point bear more centrally; and while the die at the blank end of the rivet has a slight point bearing like Fig. 1, yet it is so little, due to the head end being solidily and firmly held in the die, that it may be said the initial pressure is bearing centrally on both ends of the rivet, thus permitting it to flow into the hole while filling the radial-shaped dies. In other words, the main feature is accomplished by the rivet filling the hole before the head is formed.

Fig. 4 represents a rivet driven with round-shaped dies in comparison with Fig. 2—cone-shaped dies.

Figs 2 and 4 show relative values of the two shaped heads, each having the same quantity of material. The round head is seen to be the better and also the stronger in the shearing section of the head. It is much easier to caulk a round-head than a cone-head rivet, if such should ever be required. The first indentation of the caulking tool on a round-head rivet forms an arch or backing to the tool, which has the effect of forcing the metal down to the plate, similar to caulking the edge of a seam, while the same operation on a pan and cone-shaped head has a tendency to curl up the thin edges of the rivet on account of insufficient metal above the caulking surface.

ZOELLY STEAM TURBINE TEST RESULTS.

THE results of recently completed tests of Zoelly steam turbines have been received from the Canadian head office of Escher Wyss & Co., who are builders of these power units. The capacities ranged from 1,250 k.w. to 10,000 k.w., and the steam consumptions attained are remarkable from the lowness of the figure and from the narrow range within which increased consumption at partial loads was kept, considering that the efficiency of the generators is considerably reduced when running at loads below normal.

1,250 K.W. Zoelly Turbine.

Two 1,250 k.w. Zoelly turbines, 3,000 r.p.m. delivered to the municipal power station at Drammen, Norway. In commercial operation since January 1912. Official test caried out February 19th and 21st, 1912:

LOAD FEATURES.

	Full.	¾	½
Power in K.W. inclusive of excitation, but exclusive of power required for the condensor	1275	981	656
Overpressure at stop-valve of turbine in lbs. sq. in.	183.0	174.5	174.0
Temperature at stop-valve, deg. Fahrenheit	588	494	472
Vacuum at the exhaust branch, in inches (referring to 30 in. mercury)	29.06	29.22	29.42
Steam consumption in lbs. per K.W. and hour	12.60	13.80	14.80

5,000 K.W. Zoelly Turbine.

One 5,000 k.w. Zoelly turbine, 1,500 r. p.m. delivered and installed at the power house of Escaut, near Antwerp. Official tests carried out January 22nd and 23rd, 1912:—

LOAD FEATURES.

	Full.	¾	½	¼
Power in K.W. inclusive of excitation, but exclusive of power required for the condenser	5418	4305	3160	1184
Overpressure at stop-valve of turbine in lbs. sq. in.	167.0	168.0	173.5	169.5
Temperature at stop-valve, deg. Fahrenheit	588	556	559	520
Vacuum at the exhaust branch in inches (referring to 30 in. mercury)	28.90	29.10	29.26	29.55
Steam consumption in lbs. per K.W. and hour	11.92	12.32	12.65	14.70

10,000 K.W. Zoelly Turbine.

One 10,000 k.w. Zoelly turbine, 1,250 r.p.m., delivered for La Societe le Triphase a Asnieres. Officially tested February 12th, 1912:—

LOAD FEATURES.

	Full	1-3
Power in K.W. inclusive of excitation, but exclusive of power required for the condenser	10,006	3678
Overpressure at stop-valve of turbine in lbs. sq. in.	154.0	162.5
Temperature at stop-valve, deg. Fahrenheit	566	567
Vacuum at the exhaust branch in inches (referring to 30 in. mercury)	28.72	29.19
Steam consumption in lbs. per K.W. and hour	12.00	14.52

CENTRE FREEZE SANITARY ICE CO.

ONE of the artificial ice companies which has been in process of organization in Montreal for some time past, announces that it will begin the supply of ice in that city next season. This is the Centrefreeze Sanitary Ice Company, Ltd., of which Hon. J. A. Ouimet, president of the City and District Savings Bank, is the president. Others on the board of directors include Messrs. L. P. Berard, G. Washington Stephens, L. E. Geoffrion, A. Michaud, C. W. Vo'lman, J. B. Baillargeon, F. E. McKenna, Gordon S. Cushing and W. S. Weir, Jr.

The company controls the Centrefreeze patents for making ice for the island of Montreal, and will manufacture ice from artesian well water.

The plans provide for the establishment of manufacturing equipments in the centre of St. James Division, in Westmount, in Outremont, and in Maisonneuve. The central plant will be on Sanguinet Street, just below Ontario, where an artesian well has already been sunk. The construction of the plant is to be put in hand at once, so that it will come into operation with a capacity of 100 tons of ice per day at the beginning of next season.

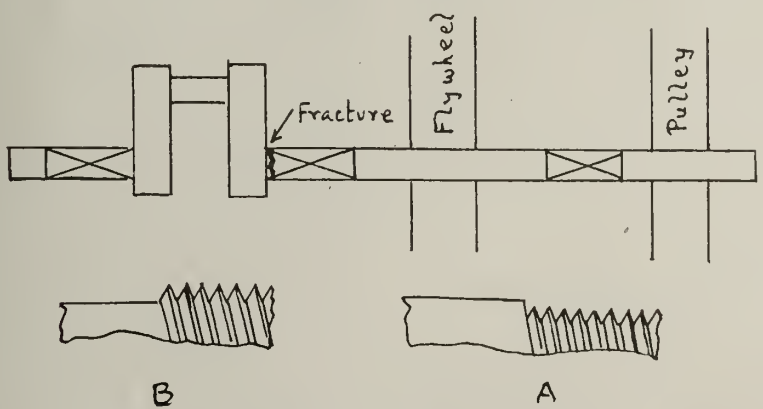
THE READERS' POINT OF VIEW

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

MECHANICAL TROUBLES IN GAS ENGINES.

By J. A. S.

IT is hardly to be expected that a prime mover such as a gas engine which consists of a collection of actively moving parts subject to heavy stresses from explosive forces can in all cases run indefinitely without a breakdown of a more or less important nature. Unfortunately, however, such a breakdown generally happens at a most inconvenient time and sometimes involves incidental damage due to the shutting down of important works processes. Some of these defects cannot be foreseen; being due to inherent defects in design or material; while others are traceable to a wrong method of treatment of the engine during operation. In order to indicate a few of the kinds of trouble which may occur to a gas engine in practice, it may be interesting to detail some actual experiences which have airsen, pointing out so far as possible the causes which led to the trouble, and where the part affected could be repaired without total replacement, the nature of the repair effected. It will not, of course, be possible in these few notes to dô anything in the way of systematising the subject, as the possible causes of breakdown cover a very wide range. It is hoped, however, that the typical cases given may be of interest to engineers who are in charge of gas engine plants.



Figs. 1 and 2—Mechanical troubles in gas engines.

Foundation Trouble.

The first case was one in which the fracture of a crank shaft occurred owing to trouble with the foundations. In this particular instance, the engine ran at about 200 revolutions per minute and had a cylinder diameter of 16 inches with a 22-inch stroke. The arrangement of the crank shaft and its bearings is shown in fig. 1. The crank itself was placed between two bearings, the shaft being extended to carry first of all a flywheel and finally an overhung pulley as shown diagrammatically. Between the flywheel and the pulley was a third or outer bearing. This outer bearing foundation eventually cracked and rotted owing to the fact that it had become covered and heavily soaked with an accumulation of oil. As is well known oil has a disintegrating effect on concrete and the mortar of masonry; the up-shot of the matter being that the foundation of the engine settled slightly. This was not noticed by the operator and the engine continued running until, owing to the fact that the three bearings were thus thrown out of line in a vertical direction, severe bending stresses were thrown on the shaft; eventually cracking it close to the crank as shown in the figure, necessitating a new shaft.

An impórtant point with regard to this particular design may be noted. It cannot be called a first-class arrangement, inasmuch as the pulley was overhung on the outside of the outer bearing; although given proper attention and an efficient foundation there is every probability that unless an excessive and violently fluctuating load was thrown on the pulley the engine would have stood up to its work. It is always advisable wherever possible, however, to avoid an overhung arrangement when transmitting large amounts of power.

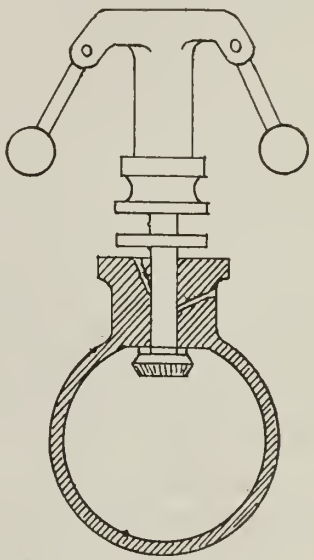


Fig. 3—Mechanical troubles in gas engines.

Gear Wheel Troubles.

In another case, a breakdown was avoided, although the indications showed that there was considerable trouble. The engine developed a heavy rattle in the gear box of the side shaft and the parts were overhauled and examined. It was then discovered that the gear wheels were not deep enough in mesh with each other, a reduction of distance between their centres of about 1-32 inch being necessary in order to have them mate properly. Repair was effected in the following manner:—The bracket carrying the gear wheel was found to have been put into place without the steadying-pin fixing its location definitely; reliance being placed on the position of the bolts and bolt holes in the main casting and bracket respectively. It was, therefore, a fairly simple matter to file

out the holes in the front bracket vertically to the required distance, allowing the bracket to be raised and the wheels to gear properly. This method of course involved entire reliance being thrown upon the mechanical grip of the bracket on the main casting when the bolts were tightened up into position but as a matter of fact no further trouble was experienced.

In another somewhat similar instance, but on a very large gas engine, it was found a somewhat difficult matter to adopt the arrangement described above, on account of the thickness of the bracket metal where the bolt holes passed through. To have slotted-out the holes in order to move the bracket would have been a cumbersome undertaking, therefore it was suggested that the steady pin which secured the bracket in a definite position should be removed and fitted in another place so that the bracket could be raised relatively to the main casting. In order that the bolts might allow of this vertical distance being altered, the original bolts which were of the shape shown in the sketch, fig. 2 at A. were removed and in their place, bolts, with a turned-down body diameter equal to that of the bottom of the thread, fig. 2 at B, were used. The clearance between the shank of the bolt and the bore of the bolt hole was sufficient to allow the bracket to be raised the required amount. It will be evident that in doing this the strength of the bolt remained exactly as before.

Governor Trouble.

Considerable trouble was experienced with the governor gear of another gas

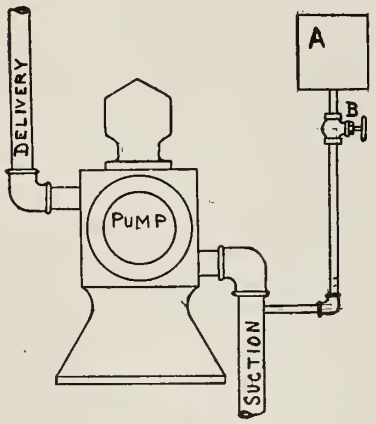


Fig. 1 – Feeding Boiler Compound.

engine, a most serious accident being only narrowly averted by the discovery that the governor spindle was tending to bind in its guide. The position of affairs will be understood by reference to fig. 3. In the neck of the casting carrying the vertical spindle of the governor, there was no provision for lubrication and to guard against any serious trouble two holes were drilled in the neck as shown, through which a small supply of oil could be fed. One of these holes emerged on the spindle at its lower portion while the other was used to lubricate the upper half of the portion of the spindle in the neck. When this was done it was found that all trouble from the erratic behavior of the governor and overheating at the neck was entirely overcome.

Gas Leakage Past Piston.

As a fine example of the peculiar nature of the difficulties which are met in connection with gas engine practice, a very interesting case may be mentioned of an engine which when first put to work on a steady run would develop a very heavy leakage of gas past the piston and in addition would give a very heavy knocking in the cylinder. It was, however, found that when the engine was fairly under way, the knocking was by no means so bad, and the leakage also took up very considerably. After an eight hours' run under these conditions the engine was stopped, the piston drawn and gauged together with the liner of the cylinder. It was found that when the parts were cold the difference in diameters was considerably in excess of that which should have been allowed for ordinary operation. The circulating water temperatures were ascertained to range between 105 and 153 degrees and as the engine could satisfactorily do its load at these temperatures the owner saw no reason to make any alterations. The interesting part of the matter is that it was apparent from the examination made, that with the high cylinder wall temperature when the engine was under a steady run, it allowed more heat than usual to be taken up by the piston, causing the latter to expand very perceptibly and consequently reduce the clearance. Had this not been the result it would of course have been necessary to insert a new liner bored to fit the diameter of the piston more closely.

The above instances are interesting as indicating the wide range of mechanical details which go to make the installation and maintenance of a gas engine plant a most instructive piece of work to the mechanical engineer.

GAUGE GLASS PROBLEM.

By E. J. N.

IT would be interesting to get at the opinion of The Power House readers regarding the following ideas on gauge glasses. Personally, I favor closing the cocks and emptying the glass in a plant where no night fireman is employed. Numerous instances are on record where a gauge glass has burst during the night, said glasses being on boilers with fires banked and more or less steam pressure being carried.

Imagine the feelings of an engineer under such circumstances when in the morning he finds the boiler room flooded and, perhaps, hundreds of dollars worth of material destroyed: About all I have ever heard said in favor of leaving water in the glass at night is that some men might start up a fire in the furnace and forget to open the gauge glass valves. Any man, however, who would break a bank and limber-up a fire without first looking at his glass and making sure it was O.K., would be either drunk, crazy or a fool and unfit to fire a cook stove.

FEEDING BOILER COMPOUND.

By John Thorn.

TWO methods sometimes adopted in feeding liquid compound to steam boilers are shown in figs. 1 and 2. In

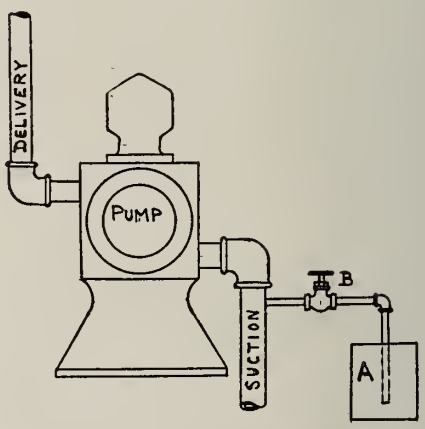


Fig. 2 — Feeding Boiler Compound.

each case, (A) is a tank of any desired size for holding the compound, and (B) a ¼ inch globe valve with pipe attached to the tank and pump suction as shown; by regulating the valve, the desired amount of compound can be fed to the boiler. If an injector is used, a branch can be attached to the suction pipe in like manner. After starting the injector, the small globe valve is carefully opened a little. It is of course absolutely necessary to note the height of compound in the tank and to close the valve before the tank gets empty, otherwise, air will be admitted to the pump suction pipe and break the vacuum. A force feed oil pump has been used with good results as a compound feeder. In this case it is unnecessary to pass the compound through the steam pump or injector as it can be forced direct into the boiler by connecting the pump and compound discharges.

BELT INFLUENCE ON MOTOR OUTPUT.

By Geo. P. Pearce.

WE had supplied a double disk mill to a large grain company whom we will call the Smith Flour and Grain Co.; also two 10 horsepower motors to drive it. Our customer said they could install the outfit and that they would furnish the two 8-in. belts for driving. They stated the number of bags of meal required per hour and did not wish us to send larger motors than necessary, as the central station charged a certain minimum per month based upon horsepower installed. We had found by experience that 10 h.p. on each side would just exceed the amount they asked and, therefore sent this size motors.

It was not long after the machinery had been shipped before we received quite a sharp letter from the Smith Flour and Grain Co., saying that they had installed the machinery exactly as shown on the blue prints, but they were unable to grind even half as much as we had claimed and that the outfit was useless to them in this state. They got electricians up from the central station, who, after a very careful test, found that the motors were o.k., but recommended that the two 10 h.p. units be replaced by two of 20 h.p. The Smith Flour and Grain Co., were of opinion that we did not know much about our own business, by installing a total of 20 h.p., when the actual requirements were at least a total of 40 h.p. The writer was bidden go and investigate the trouble. Upon arrival, I first made a trip to the central station and asked to see the records of the test. The electrical engineer, there, was very sarcastic in his remarks about theoretical calculations being all right sometimes, but when it came to grinding machinery there had to be plenty of power, and as the motors installed would never be of any use, the quicker we put in two of 20 h.p. each, the better it would be all round. The test record certainly appeared to uphold his statement.

I then went on to the mill and was received with the cheerful information that it was up to me or the firm to make that drive right at no cost to them. I examined the mill equipment and motors and found the installation O.K. Everything was in line and level. It was rather a dark place. I started the mill, and while it started up all right, I noticed it acted sluggishly, so I shut down and went into the basement to see the motors. The wires were amply large and all connections were tight. I decided, however, to try each part separately to find out the source of the extra friction, and pulled off a few of the boards that enclosed the belts. This had been done to prevent the windage of the high speed belts from carrying dust from one floor to another. I reached in to take hold of the belt, and in doing so got a surprise, for it seemed to me that the belt was ½ inch or more in thickness. I secured a light, and there, through the hole, saw the trouble —a heavy 8 in., three-ply stiff leather belt. I asked the man who was holding the light, why on earth they bought such a heavy belt to go over 10 in. and 12 in. pulleys, running nearly 5,000 feet per minute? He said it was part of the old 16-in. engine belt that they had used before changing over to electric drive, and that they had sawn it in two to make 8 in. widths out of it.

I went to the office and told the manager that the belts were the cause of all the trouble, and that if they would get suitable belts I would prove to them that the outfit would turn out the amount guaranteed. He only laughed and said that changing belts was not going to make all that difference; that the belts installed were of the highest grade and had cost a pile of money when new. Further, they had not been used much, and had given splendid service when on the engine. It was no use calling his attention to the fact that the smallest pulley on which it formerly ran was 48 in. diameter, while that in the present instance was only 10 in. I could get no satisfaction except that if I wanted to try any "stunts" before ordering the bigger motors I could go ahead at my own expense, and that I had better hustle, as they wanted cracked corn and meal at once. I was also informed that if they had to wait very much longer he would rip it all out and I could ship it back, there being a competitor with a complete outfit ready to instal at the word "go," with a guarantee on penalty to get results. I telephoned a big belt concern in the next city to send me down by express an 8 in. light double rawhide belt long enough for both machines.

The belting came in the afternoon, and I had both on in an hour, nicely laced with wire lacing. We started up and the mill rose to full speed in ten seconds. I started grinding right away, and for three hours I ground at a good 10 per cent. in excess of the guaranteed rate; at the end of which time, the motors were not more than warm. The manager had gone home without making any comment; I, however, got the miller to sign a report to the effect that he had seen the mill doing 10 per cent. better than the guarantee without sign of overload on the motors. There was no further trouble from that day to this, nevertheless, the manager put up a strong kick before he paid for the new belts, adding that he hadn't much opinion of a machine that required a special kind of belt before it would work. The saving every month on his minimum rate, by having these small motors, did not appeal to him; but, then, some people will kick anyway.

THE STEAM BOILER.

By C. T. R.

NECESSITY for the best in steam boiler material, design, workmanship, management, legislation, supervision and inspection is certainly more urgent in these opening years of the twentieth century than it has been since the introduction and development of steam power as a mighty factor in the evolution of the civilized world. Unlike its contemporary, the reciprocating steam engine, the zenith of almost practical boiler perfection has not yet been reached, nor has its existence been so seriously and successfully challenged. The steam turbine, rapidly superseding the reciprocating steam engine, gives continuity (I am almost disposed to call it permanency), to the steam boiler, making at least equal demands on its strength, safety, weight, compactness, efficiency and capacity, and opening up more extended spheres of usefulness.

This, I take it, calls for the application of increased ingenuity, skill and conscience on the part of those interested. Affecting, as it does, the convenience and safety of the public, the competitive platform of the boiler manufacturer, the maximum return in efficiency and economy to the steam user, the quality of the steel works output, the education and training of designers, tradesmen and attendants, the most suitable tools and appliances, it is apparent no apology is necessary for discussing through a series of articles in The Power House this important and far-reaching topic.

Difference of opinion exists all the way through as to the rightness or wrongness of certain conclusions (proved or otherwise), which regulate certain courses of action. Of these I am perfectly aware, yet although suggestions here thrown out may jar on minds as competent and more so, as long experienced and more so than that of the writer, it is to be remembered that we are not the whole show, that a young generation of engineers and boilermakers is growing up round us, alert, prying, pushing, with heads clear, minds unbiassed by familiarity and experience, open to test and prove, and put into practical and progressive effect what is best in their instruction and reading, and what will certainly make for improvement. Again, it is necessary, even at this late hour of the day, to enlighten, in addition, the gene-

ral public, allied and associated trades with already preconceived ideas and opinions in large measure erroneous such ideas and opinions being nothing more or less than conclusions, that because a steam boiler is uncomely to an untrained and inexperienced eye, is devoid of polish and glitter so necessary in the artistic, is minus other (in its case), useless adornments, any conglomeration of plates and rivets (so long as weight is assured), thrown together by a handy man, constitutes all there is to it. The first article will discuss the important question of.

Legislation.

Legislation is absolutely necessary and should in each country be the law for all. Were this consummation reached nationally, the steps to international codes of rules would be easily attainable, for the steam boiler is to all intents and purposes the same the world over, and the same ideal perfection is sought. Such legislation, then, from the national standpoint, and not from the provincial and civic, is really the main point, and in so far as it affects our Dominion, let me refer to it.

It should be the expression of a council of representative men, a commission, if you like, whose patent of being has the seal of State, whose deliberations and conclusions are untrammelled by such seal, and whose integrity of character and fitness for the work are beyond question. Such men are the "rara avis" in the engineering world, and their recommendations and findings incorporated in the Statute Book would tend mightily towards an ideal boiler. Our Canadian Manufacturers' Association, an organization which has the best interests of our country at heart, is to my mind best fitted to put this question on a proper basis. Could not a section of those directly concerned, supplemented by the addition of the expert advisers of each individual maunfacturer and consulting engineers of authority and repute, be constituted a commission of investigation?

Codes of rules, the outcome of the deliberations of such a body, backed by the weight of the whole Manufacturers' Association, could not fail to have the support of the public, and would consequently become law readily. Existing rules there are in abundance, yea, in superabundance, but just here is the weak spot. The law for the east should be the law for the west, the law for the city that of its suburbs, and the enforcer of the law, representative government advised and guided as stated. Those who guard the law should be men of honor, fearless in the discharge of their duty, and those who manufacture should respect the law to its uttermost limit. Much hard work lies before such a commission. Much wrangling and discussion is ahead. Many imperfections, which time only will eradicate, will be apparent in a new set of rules, and particularly to those persons whose pet ideas have not been incorporated; but out of all, a much improved boiler will be evolved, and what is not of little importance, a fairer and more satisfactory competitive manufacturers' platform will be established, a point in its ultimate bearing which affects everybody more or less.

Young, then, though we be as a manufacturing country, it may be our lot to set up the basis from which international codes of rules will govern all steam boilers, and there is no reason why we should not be in the forefront. We have resources unlimited as a country, and as individuals we have a fair share of genius, ability, experience and push. While water power, on account of our natural resources, will necessarily be largely utilized, and electrical power also play an important part, it remains that steam power there must be, and to the extent of the adaptability of our generator will be the extent in our country's development of the part it will play.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

LEAKY VALVE SPINDLES.

By Blackthorn.

SEVERAL steam and water valves caused much annoyance by leaking at the packing glands, due, doubtless, to old packing having been allowed to remain in the stuffing boxes which scored the rods and made it impossible for new packing to last more than a day or two. We secured some very thin tea lead, packed it firmly into the lower half of the stuffing box and on top placed about half the usual quantity of regular packing. The foregoing method of overcoming troublesome spindle leakage has been under test for several weeks now, and appearances are such as to make us feel proud of our achievement.

INSULATING ROTOR BARS OF SQUIRREL-CAGE MOTORS.

By G. A. V.

THE following kink which I have used with much success in insulating the rotor bars of squirrel-cage motors where the rotor slots are circular, may be of service to some of your subscribers.

To put in the paper tube, obtain a piece of round copper, one B. & S. gauge smaller than the size of the bar. Cut a slot with a fine hack saw about one-third of the distance through the bar and a few inches longer than the width of the rotor slot. Cut the fibre to suitable width and length, and after inserting the slotted bar, place the fibre in the slot, then turn the bar until the fibre is wound around it and inside the slot. The bar may now be removed and the rotor bar pushed into the fibre tube. Covering the bar with paraffin assists greatly in getting it in place. The whole operation is simple, rapid and easily performed.

A.J. F., Vernon, B.C., suggests the following query as an introduction to a series of regular discussions in which operating engineers and others might profitably engage through the columns of The Power House each month: If the distance between the centre line of the handle and that of the axis of a windlass drum be 18 inches and the diameter of the latter be 6 inches, what force will be required on the handle to raise a load of 300 pounds?

Stratford, No. 31, C.A.S.E. — On Tuesday evening, June 25, at a largely attended meeting of members, the following officers were elected for the ensuing year:—

Past President.—A. Kastella.
President.—J. A. Innes.
Vice President.—James Swanson.
Financial Secy.—J. A. Robertson.
Recording Secy.—J. F. Smith.
Treasurer.—George Hird.
Conductor.—Oliver Poole.
Doorkeeper.—James Easson.

A. Kastella and Alex. Scrimgeour were appointed delegates to the C.A.S.E. convention which meets at Belleville on July 23, 24, 25.

Owen Sound, No. 25, C.A.S.E.—A good attendance of members is reported at

the weekly meetings held every Thursday evening, and profitable discussions are taking place on the development and progress in evidence concerning power plant equipment. At a recent open meeting, Bro. G. Fowler read a paper on "Lubrication," which was much appreciated.

ENGINEERS' OFFICERS.

THE International Union of Steam Engineers held their largest meeting of the year at the Labor Temple, Toronto, recently. The reports for the past year show that financially they did well and their membership doubled. The election of officers resulted as follows:—President, J. G. Jones; Vice-President, J. Shaw; Treasurer, T. J. Walsh; Recording Secretary, J. J. Harris; Conductor, J. Bishop; Guard, E. Smith; Trustees, J. Lawrenson, E. Baynton, S. Brown; Auditors, Geo. Mott, Alex. McCrae, Robert Sheppard; Delegate to the International Convention which meets in St. Paul, Minn., J. G. Jones.

Trade Gossip

H. L. Peiler & Co., of Montreal, have opened a special department to deal with the question of combustion, forced draught, gas and oil engines. L. H. Bacque is engineer in charge of this work.

The Canadian Morehead Mfg. Co. has been organized, with headquarters at Woodstock, Ontario. Return and non-return vacuum traps and condensers will be manufactured. G. H. King, Woodstock, is president and general manager.

Plastics, Limited, of Toronto, have appointed the General Supply Company of Canada, Ltd., Ottawa, sales agents in Manitoba, Alberta and Saskatchewan for "Bakelite" valve discs and pump valves. This business will be handled from the Winnipeg branch. "Bakelite" valve discs and pump valves are being widely recognized by the trade.

The Murphy Iron Works, Detroit, Mich., recently executed their fourth order for Murphy furnaces from The Laurentide Co., Ltd., Grand Mere, P.Q. This firm have had experience of the furnaces since 1905, and their installation now embraces 14 sets, of a total of 4,250 horse power.

The Linde-Canadian Refrigeration Co. recently opened a branch office in Winnipeg which will handle all business in Manitoba and West as far as Calgary, Alta. Mr. F. H. W. Guard has left the Montreal office to take charge of this territory, and Mr. R. P. Mason has been appointed refrigeration engineer to succeed Mr. Guard.

Alberger Pump and Condenser Co.—Announcement is made, dated as from June 1st, 1912, that the three associated concerns, the Alberger Condenser Co., Alberger Pump Co. and the Newburgh Ice Machine and Engine Co., will in future be known as the Alberger Pump and Condenser Co. The officers of the new company are George Q. Palmer, president; William S. Doran and D. H. Chester, vice-presidents; and William R. Billings, secretary-treasurer. The head offices are at 140 Cedar Street, New York. The large amount of condenser and centrifugal pump orders in hand has demanded important additions to the plant and equipment of the works at Newburgh, N.Y. The line of apparatus manufactured by the Alberger Pump and Condenser Co. consist of surface, jet and barometric condensers of various designs, cooling towers, a complete line of volute and turbine type centrifugal pumps, steam turbines, feed water heaters, hot water service heaters, and expansion joints.

The C. O. Bartlett & Snow Co., of Canada have been incorporated recently. Their headquarters are in the Jacobs Bldg., Montreal, and H. S. Hersey, late manager of the Dodge Mfg. Co., is Canadian manager. They intend starting a factory ultimately, but it may two or three years before this object is accomplished. The firm are engineers and manufacturers of elevating and conveying machinery, of direct and steam heat dryers, screens, hoists, coal and ash handling machinery, garbage disposal plants, sand and gravel machinery, mine equipments, etc. There will be a competent local engineering staff who will have full access to all of the data which has been accumulated by the parent house in Cleveland.

Siemens Brothers, Dynamo Works, London, England, with Canadian head office at Canadian Birkbeck Building, Toronto, have recently booked the following contracts: A repeat order from the City of Regina for a 400 K.W. 550-600 volt, 450 R.P.M. direct current compound wound generator with commutation poles, direct coupled to a Bellins & Morcom vertical high speed engine; the complete set being a duplicate of that which has now been running for nearly a year.

From the City of Edmonton:

1.—2,000 K.W. 3,600 R.P.M., 3-phase 60 cycle turbo generator for direct coupling to a Williams & Robinson turbine.

1—750 K.W. 280 R.P.M. direct current, 500-575 volt, compound wound generator with commutation poles for direct coupling to a Belliss & Morcom high speed vertical engine.

1—425 H.P. 3-phase, 60 cycle, 450 R.P.M. slipring motor, with short circuiting and brush lifting device.

The 750 K.W. generator will be fitted with Siemens split commutator, where the commutator is made up in two sections. Electrically, this arrangement is just the same, but mechanically it is far stronger and has the particular advantage that, as the bars are only half the length they would be if made in one piece, the chances of distortion, due to temperature or mechanical stresses set up in running, is avoided.

Berlin, Ont.—The Waterworks Commission has awarded the contract for a million-gallon reservoir in connection with the new $100,000 extension plant, which is in progress. John Paterson, of St. Mary's will construct the reservoir at a cost of $15,450. A new $500,000 standpipe will also be erected.

The Canadian Crocker Wheeler Co., Ltd., St. Catharines, Ont., have opened a Toronto office at 628-629 Traders Bank Building in charge of Mr. E. T. Mug.

Mr. William H. Marsh, who for the past ten years has been connected with the Standard Underground Cable Co., of Pittsburg, Pa., in the capacity of Superintendent of Construction, has been appointed Secretary and Assistant Treasurer and Sales Manager of the Standard Underground Cable Co., of Canada, Ltd., with headquarters at Hamilton, Ont.

Mr. H. G. Burd, who for some time has been connected with the Standard Underground Cable Co., as sales engineer in the New York office, has been appointed assistant to the sales manager of the Standard Underground Cable Co., of Canada, Ltd., with headquarters at Hamilton, Ont.

Chapman & Walker, Ltd., Toronto, have recently secured the following orders for pumping equipment:—City of Edmonton, one W. H. Allen & Co., Bedford, England, Standard make centrifugal pump capable of discharging 4,200 gallons per minute against 55 feet head, when direct connected to their enclosed high speed engine of 105 h.p., running 475 r.p.m. Two vertical sewage pumps capable of discharging about 470 gallons per minute, for installation in the Nelson Avenue Pump House.

Port Arthur, Ont. — One centrifugal pump capable of delivering 1,000 gallons per minute against 190 ft. head.

The Electrical Products Co. of Canada, agents for T. Harding Churton & Co., Leeds, England, will in future carry a small stock of motors ranging from 5 to 20 h.p. at their Toronto headquarters. Arrangements have been made whereby larger sizes may be had promptly from factory stock.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

IMPROVED SAFETY NON-RETURN BOILER STOP VALVE.

THE great importance of non-return boiler stop valves for use on a battery of boilers is universally acknowledged, and in some countries their installation is compulsory. It is evident that should a tube be blown out or a fitting ruptured in one of the boilers of a battery, the steam from the others would rush into the header and discharge into the disabled boiler. An ordinary stop valve would here be inadequate, as considerable time would necessarily be consumed in reaching and closing it, and a certain amount of danger must be anticipated. The non-return safety boiler stop valve shown herewith has been given very severe tests, and is in use in a large number of high pressure power plants, in all cases giving perfect satisfaction.

Valve Feature.

Fig. 1 shows this improved valve applied to a battery of boilers in the plant of the New York Rubber Co., Matteawan, N.Y. Fig. 2, a vertical section of the valve parallel to the pipe, and Fig. 3, a section at right angles to the pipe When these valves are used, should an accident occur, such as the blowing out of a tube in the boiler or any rupture of the headers, shells, etc., permitting the steam to escape, the valve attached to the boiler will immediately close. This will prevent the escape of steam from the other boilers connected with it in battery, and the danger to life and property will be greatly lessened. The plant can be operated with the other boiler or boilers, without interference, thereby preventing the closing of same and the loss of time and money. This valve will prevent steam from being turned into a boiler which has been cut out for cleaning or repairs, as it cannot be opened by hand when pressure is on the header side. It can, however, be closed when desired. The valve can be connected in either horizontal or vertical position.

A unique arrangement of outside spring and lever mechanism has been provided for the purpose of effecting a slight counter-balancing effect to hold the valve open; this being necessary in order to counteract the influences within the valve or line which tend to actuate the disc with every slight fluctuation of pressure. These fluctuations, usually caused by the engine, are frequently met within steam lines, and unless some means, such as are shown in this construction, are applied to counteract them, the disc will be kept in continual motion, and with lack of lubrication within the dash-pot, rapid wear will soon take place, thereby establishing a clearance between the piston and the dash-pot. As the amount of clearance increases, the dash-pot becomes less effective and a chattering soon results, causing great damage to the internal parts of the valve.

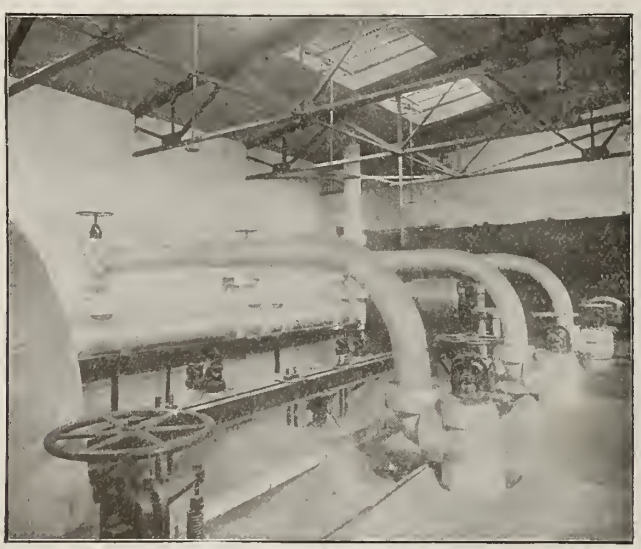


Fig. 1—Battery of boilers with improved safety non-return stop valves.

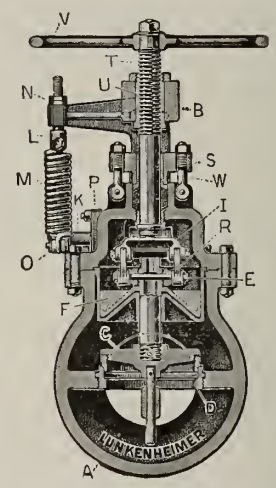


Fig. 3—Improved safety non-return boiler stop valve.

Where the fluctuations of pressure do not exist and the flow of steam is steady, the use of the exterior spring and lever mechanism is not necessary. Hence, the valves are regularly furnished without tension on the spring, and the dash-pot arrangement can here be depended upon to cushion the movement of the disc. Should a pulsating condition develop, which can easily be detected by observing the movement of the spindle L., the regulating nuts, N, can be adjusted, gradually placing the spring under tension, until the rapid movement of the spindle L is stopped. This adjustment of the nuts tends to lift the disc from off its seat as it places the spring under tension, causing it to pull upon the lever O. This lever is keyed to the shaft K, which shaft enters the valve through the stuffing-box P. Attached to the shaft O, is the forked arm I, to which are pivoted the links R, which in turn, are loosely connected to the piston F. When the spring is under tension, the disc is raised from its seat and cannot close until the

steam pressure above the disc exceeds that under it. This difference in pressure, which is governed by the tension of the spring, is never more than five pounds. When the valve is properly set to overcome the tendency of pulsation, the disc remains practically in equilibrium until there is a reduction in pressure on the inlet side, when it will instantly close.

Attention is called to the large bearing surface of the piston within the dashpot. All parts of the valve subjected to wear are renewable, and this includes the disc and seat ring, though the seating faces of the disc and seat ring can be reground a number of times before it is necessary to renew these parts. The stuffing-box, through which the stem T travels, is of large size and entirely exposed to the cooling effects of the air. It can be packed under pressure when the stem is raised to its limit, as a shoulder on the bottom of the stem forms a seat against the bronze bushing in the bottom of the stuffing-box. The stem T operates in the bronze hub U in the top of the yoke and bronze bushings in the gland and stuffing-box, thereby preventing corrosion and insuring easy operation. These valves are made in five different combinations of materials in order to suit the requirements of various conditions of superheat and high pressure, and also to meet the specifications of engineers who may differ as to what is best suited to the purpose.

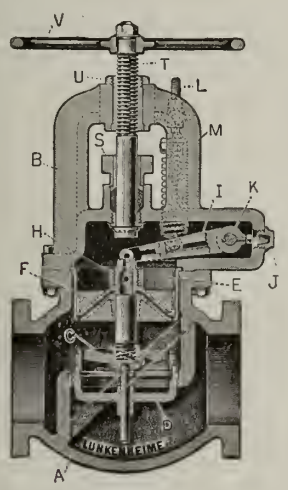
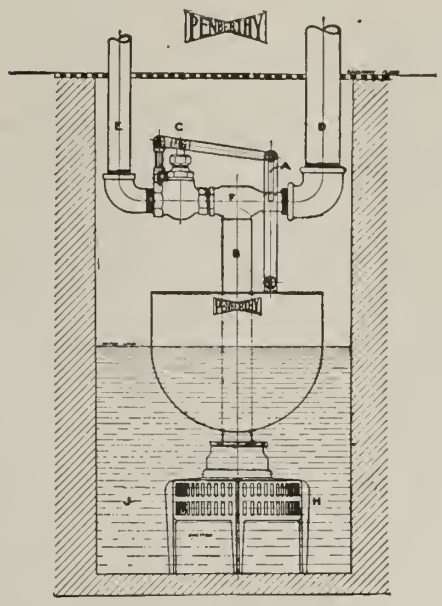


Fig. 2—Improved safety non-return boiler stop valve.

The Lunkenheimer Co., Cincinnati, Ohio, are the manufacturers of these valves.

PENBERTHY AUTOMATIC CELLAR DRAINER.

THE Penberthy Automatic Cellar Drainer is a water pressure ejector of high capacity, automatically operated by a float-controlled, quick-opening-and-closing valve (C). This valve is never partially opened—it cannot leak, and allows the ejector to give its greatest efficiency by working to full capacity. The float arms are slotted at (A), where they connect to the valve lever (C). This prevents the ejector from operating



Automatic Cellar Drainer.

until the water has raised the float up to the highest point, and, as the water is ejected, they travel down the length of these slots before the weight of the float affects the valve, allowing the machine to work for longer periods and not so often, and preventing considerable wear, leakage and dribbling of water.

To enable the installation of this drainer in small holes or sumps, it has been made as compact as possible. The float, instead of being round, is flat on the top, and has more buoyancy and occupies less space than a round float of the same diameter. It is further economized on space by building the float around the suction pipe (B). This patented feature has the added advantage of being rigid and overcomes all the trouble of the common loose float. The balance of the drainer is built directly above the float; this not only keeps the whole machine in as small a space as possible, but also keeps all working parts, with the exception of the strainer and float, above the water, thus preventing corrosion, or the exterior parts becoming clogged up by deposits of slime, dirt or sediment. The interior parts are prevented from coming in contact with any foreign particles by the special strainer (H), which is so constructed that instead of the water being drawn directly upward, it is taken in at the sides, allowing all sediment to collect under the strainer without being disturbed by the force of the suction. There is also a foot valve ionside the strainer which closes the moment the drainer ceases operating, holding all water in the pipes, primed for starting instantly at the next filling of the sump.

The Penberthy Automatic Cellar Drainers are particularly adapted for use in pits, sumps, cellars, tanks, settling basins, or wherever it is desired to keep water or other liquids from going above a certain level. They are made of best bronze metal, except the float, which is copper, and can be regulated for any water pressure.

ELECTRIC HEATING.

CHEAP hydro-electric power generated on the Snake River has caused the rapid development of the city of Twin Falls, Idaho, and has rendered practicable the electric heating of buildings. In the vicinity of Twin Falls electric heating units to the extent of almost 1,000 k.w connected load have been installed in place of steam radiators. A six-room house uses $70 to $100 worth of electrical energy during the season of eight months, and a building having stores and offices on the first floor and a ball room on the second story uses 100 k. w. at a cost of $625 for the season. Three-phase current is brought into the latter building at 2,300 volts, and is transformed to 220 volts for use in 40 electric radiators and a water tank heater, which keeps the water continually at the boiling point through thermostatic control. The size of the building is 50 feet by 120 feet, and the electrical equipment, exclusive of the transformers,

Automatic Cellar Drainer.

which were supplied by the power company, was approximately $1,000.

The merits of the steel asbestos filled gaskets are many, they go on and off the plates easily, there is nothing in the gasket that can melt and bake on the plates and header, thus leaving them clean always. They do away entirely with the hard job of cleaning plates, which in a large power plant is quite an item.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

Trail.—P. Burns & Co., Ltd., of Trail, B.C., have let a contract to the Armstrong Machinery Co., of Spokane, for the supply and erecting of a 1-ton direct expansion refrigerating plant.

Alberni.—A project is under way for establishing here a fish freezing and storage plant at a cost of approximately $250,000. The Alberni Board of Trade is assisting the enterprise.

Victoria.—P. Burns Co., Ltd., are having their branch market in this city equipped with a 12-ton refrigerating plant furnished by the Triumph Ice Machine Co., Cincinnati, Ohio.

Vancouver.—P. Burns Co., Ltd., are having their Grandville Street market equipped with a 12½-ton refrigerating plant furnished by the Triumph Ice Machine Co., Cincinnati, Ohio.

Vancouver.—P. Burns & Co. are installing in their Edmonds meat market a 1-ton refrigerating machine furnished by the Armstrong Machinery Company, Spokane, Wash.

Vancouver.—The New Westminster Co. will install a 16-ton ice making and refrigerating plant furnished by the Triumph Ice Machine Co., Cincinnati, Ohio.

Rossland.—Anticipating the electrification of the Canadian Pacific Ry. from Castlegar to Rossland, B.C., the directors of the West Kootenay Power & Light Co. will increase the capacity of the No. 2 plant at Bonnington Falls. This plant has two units of 6,600 h.p. each, to which an 8,000 h.p. unit will be added, making 21,200 h.p. available. When the plant was built, space was allowed for two additional units. With the increased power, all of the trains on the Columbia & Western branch of the Canadian Pacific Ry. can be handled with power to spare. Before the road can be electrically operated, poles for the trolley wires will have to be erected. Presumably, the overhead rather than the third-rail system will be adopted. The latter, besides being a menace to life, would hardly work advantageously where there is so much snow. It will be several months before this section of the road is ready for operation.

Summerland.—This town is considering the relative advantages of a hydro-electric plant or one operating by steam or crude oil.

Vancouver.—The Swift Canadian Co. are having their storage house in this city equipped with a 35-ton refrigerating machine, furnished by the York Manufacturing Co., York, Pa.

Point Grey, B.C.—A $1,500 contract for the supplying of galvanized piping for use in extending the water supply system of the municipality has been awarded to Messrs. Robertson and Godson, of Vancouver.

New Westminster, B.C.—The ratepayers have voted $400,000 for road and waterworks extensions and city enterprises.

South Vancouver, B.C.—The Fire, Water and Light Committee has decided to ask quotations for 25 miles of 4-in. water piping and 10 miles of 6-in. water pipes, at an estimated cost of $70,000.

Nanaimo, B.C.—The ratepayers defeated the waterworks extension by-law which called for the expenditure of $15,000.

Chilliwac, B.C.—The sewerage by-law which involved the loan of $75,000 was defeated whilst the following by-law was passed: Waterworks $144,000.

Penticton, B.C.—The council of this municipality will call tenders on a 200 b.p. Diesel engine to be used as motive power in the lighting plant of the town.

ALBERTA.

Edmonton.—O'Donnell, Clark & Co. will install a 5-ton refrigerating machine, contract for same having been let to the Armstrong Machinery Co., Spokane, Wash.

Lethbridge, Alta.—The burgesses recently endorsed the following by-laws:—$40,000 for electric light extensions; $10,000 for street railway; $25,000 for fireball, etc.; $39,000 re purchase of road roller; $83,000 re sewage system; $42,000 waterworks extension.

Calgary, Alta.—Ratepayers of Calgary will shortly be called upon to authorize the expenditure of $1,053,600 for the improvement of a gravitation system which is supplying the city water. City Engineer Childs has submitted figures of the estimated cost The proposed plan is to duplicate the present pipe line from a point about two miles further up Elbow River than the intake of the present system, and run it into the city to join the city waterworks system at a point near the reservoir in southwest Calgary. Sedimentation tanks at the intake are provided in order to make the water as clear as possible, and a filter basin near the reservoir. The estimated cost of the new main is $738,600; the sedimentation tanks at the intake and the enlargement and lining of the reservoir, $15,000; and the installation of 12,000,000 gallon capacity filters, $200,000.

Macleod, Alta.—The by-law empowering the town to borrow $100,000 for municipal building was approved of by voters.

Medicine Hat, Alta.—The by-law calling for the expenditure of $4,200 for industrial sites was recently approved by the ratepayers.

SASKATCHEWAN.

Regina.—The contracts for the cast-iron pipe and specials for the construction of water main extensions were awarded to the National Iron Works and the Canada Iron Corporation. The former is to deliver 200 tons of pipe and 8 tons of specials at a cost of $8,854, and the latter 146 tons of pipe and 5 tons of specials at a cost of $6,472.

Regina.—Orders have been placed by the commissioners for the purchase of an engine casting $3,565 from Crossley & Company, of London, England, and a pump costing $740 from the Canada Foundry Company. This will be a duplicate unit to the one already installed at the pump well house, and will be capable of pumping four million gallons of water a day.

North Battleford, Sask.—The Canadian Westinghouse Company have received the contract calling for the supply and erection of a 500 kw. generator and equipment, the price being $5,580.

North Battleford, Sask.—Messrs. Laurie and Lamb have received the contract to erect and furnish a 750 h.p. steam engine.

North Battleford, Sask.—The contract calling for the erection and supply of a boiler has been awarded to Messrs. Babcock & Wilcox, Ltd., the price being $8,700.

Saltcoats, Sask.—The municipal authorities of this town are about to issue debentures for the installation of electric light facilities. The estimated cost for the work is placed at $17,000.

Regina, Sask.—The ratepayers refused to sanction the bonus to the Ontario and Manitoba Flour Mills Company. By the proposed scheme the city was to guarantee the company's bond to the extent of $200,000.

Battleford, Sask.—The ratepayers sanctioned two by-laws recently. They provided for the raising of $100,000 for electric light extension, and $50,000 for building of sidewalks.

Wainwright, Sask.—The burgesses recently endorsed a by-law to raise $25,000 re erection of a flour mill.

Battleford, Sask.—The sum of $100,000 will be spent in the near future upon the extension of the electric light system here.

Saskatoon.—The Saskatoon Pure Milk Co., A. Mihalko, manager, is establishing a modern sanitary dairy, creamery and ice cream manufacturing plant, and will install a 4-ton and possibly also a 12-ton refrigerating plant, arrangements for which have been practically completed.

Melfort.—By a vote of 89 to 0 the ratepayers of Melfort have passed three debenture by-laws, totalling $120,000, for waterworks, sewers, sewerage, trunk sewers and electric plant system. Tenders have been accepted for these divers constructions and work will be started shortly.

MANITOBA.

Winnipeg.—The Manitoba Cold Storage Co. is having plans completed by Chicago architects for an additional cold storage warehouse of about 1,000,000 cubic feet capacity, the building to be 105x160 feet and seven storeys high. Refrigerating and ice-making systems will be installed.

Winnipeg.—The Western Canada Cold Storage & Packing Co., organized at Winnipeg, with $550,000 capital, will acquire the plant and assets of the Central Canada Meat Packing Co., at Medicine Hat, Alta., and, it is stated, will also establish a plant at Winnipeg.

Minnedosa, Man.—The bonds of the Minnedosa Power Company have been guaranteed to the extent of $40,000 by the citizens here.

Winnipeg.—The Grange Hotel is being equipped with a 4-ton York refrigerating plant, by the Kent Co., Montreal, Que.

ONTARIO.

Toronto.—The Briar Hill Dairy Co. has equipped its dairy with a 6-ton refrigerating plant, furnished by the York Manufacturing Co., York, Pa.

Sarnia.—The new plant of the Sarnia Gas & Electric Light Co. was destroyed by fire on the morning of June 27. The loss is estimated at $300,000.

Kingston.—Kingston will not take electrical power from either the Seymour Company or the Hydro-Electric Commission. It received quotations from both these concerns, and finally submitted them to R. S. Kelch, electrical expert of Montreal, whose report has been received by the Civic Utilities Committee. Mr. Kelch advises that the city should accept neither proposition, and intimates that the city's present steam plant, with certain additions, can take care for a number of years of the local demand for power, and can furnish it cheaper than that from the Commission or the Seymour Company. Mr. Kelch's report will be adopted by the City Council.

Winona.—Smith, Kerry & Chace have called for tenders for a turbine pumping unit.

Islington.—Etobicoke township may have a municipal electric distributing plant for its own municipality. At a recent meeting several petitions for electric energy were received, making nearly a dozen places in the township desiring Hydro power. It was decided that the council should apply to the Hydro-Electric Commission for an estimate of the cost.

Severn River.—The Hydro-Electric Commission has begun work on the details of the plans to supply power to another circuit, comprised of Collingwood, Stayner, Coldwater, Barrie, and Elmvale. The cost of the plant will be $198,000. With the building of this transmission line, the Hydro-Electric has practically laid a network over western Ontario. The people of the five towns which have just made the agreement with the Commission will pay a similar rate to those who used the power in the Niagara belt. The Commission will get the power from the Simcoe Railway & Power Co., whose plant is at "Big Chute," on the Severn River.

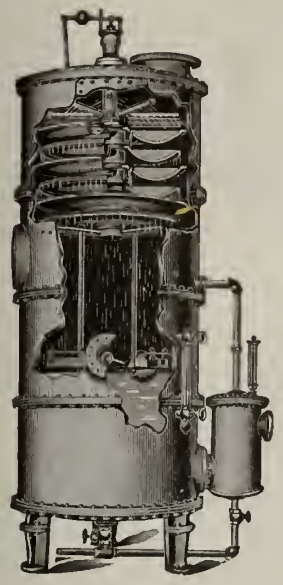
Galt, Ont.—The extension of the Hydro-Electric system here is being considered by the citizens. The cost of completing system will be about $45,000.

Blyth, Ont.—The burgesses ratified by-law to grant a loan of $5,000 to the Blyth Flax Mill Co.

Beaverton, Ont.—The municipal council have applied to the Hydro-Electric Commissioners for a specific volume of current. Beaverton is the first municipality in that district to make such an application.

Guelph, Ont.—The annual report of the Light and Heat Commission shows that this department has produced a profit of nearly $23,000 for the year ending December 31st,

BOTH DURABLE AND EFFICIENT



Approximately each 11 deg. increase in the temperature of feed water effects a fuel saving of one per cent. This alone convinces you of the advantages gained by installing a Feed Water Heater.

Will it be an open or closed heater? Disregarding the lower cost of maintenance of the open heater, the economical saving of one pound of steam for every seven pounds of water heated, satisfies you the open feed water heater is the best.

Get the *Pittsburgh Feed Water Heater.* It is the *best* and is of the *Open type.*

The *Pittsburgh* has all the latest and most up-to-date improvements. Its efficiency is of the highest and its construction is superior to all others.

The *Pittsburgh* is strong and durable. It is built to outlast anything in the plant. The shell is circular with *machined flanges bolted together.*

Investigate the *Pittsburgh* and *you will install no other.*

ELLIOTT COMPANY

6902 Susquehanna Street, Pittsburgh, Pa.

CANADIAN REPRESENTATIVES:

Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

You Can See Results With A Liberty Tube Cleaner

Cyclone for Air or Steam

No guessing about the work the "LIBERTY" does. It puts the evidence—scale removed—right there before your eye.

After it's through with a boiler tube, there's no scale on it, hiding away, waiting to collect more.

Special features compared with other cleaners? Yes! The freely swinging arm head which enables the cleaner to get right next to the iron without harming it. That's the big point and there are others.

Send for a "LIBERTY" on 30 days' trial. See how much better it cleans your boiler tubes.

Write now for Catalog.

Liberty Manufacturing Co.

6904 Susquehanna Street, Pittsburgh, Pa.

CANADIAN REPRESENTATIVES;

Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

The advertiser would like to know where you saw his advertisement—tell him.

1911. The following shows the mauner in which this amount is made up:—

Total income	$110,188.35
Total expenditure	76,748.97
Net gain	$ 33,439.38
Debenture interest	10.738.85
Balance carried to credit of profit and loss account	$ 22,700.53

The income in the gas department was $55,495.34, and in the electric department $54,-693.01. The total income was $110,188.35. Expenditures in the gas department were $37,-603.59, of which salaries, $6,074, and labor (purification), $21,082.22, were the chief items. In the electric department's expenditure of $28,004.09, the cost of the Hydro-Electric power, $16,437.01, and $3,291.49 for general repairs were the chief items. There were $6,141.29 of general expenditures, and $5,000 depreciation, showing a grand total expenditure of $76,748.97. The balance sheet submitted by the auditors showed assets of $464,-400.28, and total liabilities of $269,253.96, principally for debentures, due bank, city of Guelph and open accounts. The contingent fund for depreciatiou stands at $75,000, and there is a premium of $4,337.20, written up for reserve fund.

Port Dalhousie, Ont.—The by-law calling for the raising of $10,000 for electric lighting system was recently eudorsed by the ratepayers.

New Hamburg, Ont.—The by-law granting a loan of $20,000 to the Electrical Specialties Company, was recently sanctioned by the ratepayers.

Amherstburg, Ont.—The ratepayers voted in favor of the loaning of $10,000 to the new automobile company and the new knitting factory just starting operations.

Hamilton, Ont.—The Des Moines Manufacturing Company, of Des Moines, Iowa, have received the contract to construct a water tower here, to cost $4,990.

Coldwater, Ont.—The Hydro-Electric system is about to be installed here.

Ottawa.—The Alexandra Hotel is being equipped with an 8-ton refrigerating plant furnished by the Triumph Ice Machine Co., Cincinnati, Ohio.

Port Arthur.—The Fitzsimmons Fruit Co. have fitted up cold storage rooms and equipped same with an 8-ton "York" refrigerating plant, iustalled by the Kent Co., Ltd., Montreal, Can.

Toronto.—The Toronto General Hospital has been equipped with a 17-ton "York" refrigerating plant, installed by the Kent Co., Ltd., Montreal.

London.—The Dominion Abattoir Co., London, E. Rechnitzer, manager, has made arrangements for erecting a packing house to cost about $100,000 at Pottersburg, a suburb of London.

Hamilton.—As soon as the deal between Mackenzie & Mann is completed, the head offices of the Dominion Power & Transmission Co. will be moved to Toronto, according to information which leaked out of the inner sanctum of the terminal building. W. C. Hawkins, who for the past five or six years has been general manager of the D. P. & T. Co., and representative of the bondholders, who are nearly all Chicago people, will retire from the concern. The general and operating offices of the company will still be retained in the terminal building. The new owners will spend $1,500,000 to install a steam auxiliary plant for the street railway and suburban lines. It is the intention to remodel the old street railway power house which has been out of use for years and equip it with a steam plant that will tide the railways over any interruption in the Niagara or Decew Falls power service. The old street railway power house is situated on the Bay shore, next to the former Hamilton Steamboat Company's dock, and it is the inteution of Mackenzie & Mann to build a dock for the purpose of bringing the coal supply here in boats.

Bracebridge, Ont.—Two by-laws were recently endorsed by the ratepayers. They provided for the raising of $5,000 re reservoir, and $7,000 for spring water extension respectively.

Barrie, Ont.—The Hydro-Electric by-law was recently sanctioned by the ratepayers. A by-law to raise $7,000 for extension of the Barrie electric light plant was also passed.

Waterloo, Ont.—The by-law to grant $10,000 as a loan to Chas. Kreutziger re erection of a box factory was carried by a majority.

Niagara Falls, Ont.—The by-law appropriating $3,000 to purchase site for Pollard Machine Co. was passed.

Fergus, Ont.—The burgesses voted in favor of the Canadian Cereal Co. by-law, also in favor of the waterworks by-law.

Woodstock, Ont.—A majority voted in favor of the by-law to grant a loan of $3,500 to the Woodstock Automobile Manufacturing Company.

Perth, Ont.—A by-law to loan the Perth Shoe Co. $25,000 was defeated by the ratepayers.

Eganville, Ont.—The Ontario Government will purchase $11,500 of debentures for school purposes.

Port Arthur, Ont.—The burgesses recently passed the following by-laws:—$1,400 re street railway improvement; $11,500 for laying steel rails on the Fort William road; $15,000 for electric light extension; and $19,000 for a site for a public market.

Exeter, Ont.—The ratepayers recently endorsed by-law placed before them to raise $5,00 for the improvement of the sewerage system.

Toronto, Ont.—Assistant City Engineer George G. Powell has recommended the construction of 13 additional filters at the filtration plant, at au estimated cost of $735,-000, along with a uew pipe line to the tunnel, at a further cost of $140,000. The Board of Control has decided that plans and specifications should be prepared at once.

Caledonia, Ont.—The Hydro-Electric Power by-law was passed by the ratepayers recently.

Coldwater, Ont.—The ratepayers voted in favor of the Hydro-Electric by-law recently submitted.

Barrie, Ont.—The Barrie electric light plant is to he extended soon, as $7,000 was recently voted for that purpose.

Galt, Ont.—The ratepayers will vote on a by-law to raise $45,000 to complete the hydro-electric system of the city.

Toronto, Ont.—The Canadian Fairbanks-Morse Co., Toronto, are planning the erection of a large tractor shop on their property at Bloor Street west, Toronto. The plans and specifications of this building are being prepared by T. Pringle & Son.

Port Arthur, Ont.—The ratepayers have passed a by-law whereby the city will buy 33 per cent. of the shares of the car manufacturing company about to commence business here.

QUEBEC.

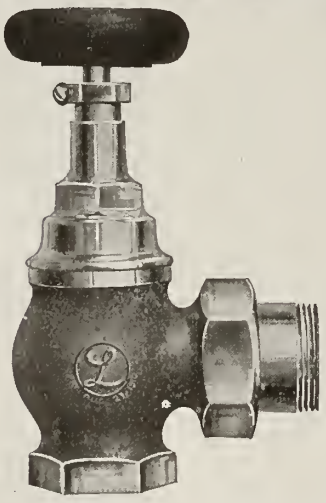
Drummondville.—A disastrous fire occurred in the electric power house here on June 17.

Sorel.—The town council contemplates the purchase of two new electric motors and three piston pumps.

DO NOT LOOK for this Ad. next month.
It will not appear again till we fill orders now on hand

THE IDEAL PACKLESS VALVES

"Made in Canada."



Simplicity and Durability

GLOBE, ANGLE and RADIATOR

Fitted with Composition Discs suitable for all pressures, Steam, Oil, Gas, Etc.

High Grade High Pressure

If in installing a Steam Heating Plant you satisfy yourself on every other phase of its construction, and rest content with a poor or cheap valve, you have bought nothing more than a poor or ordinary plant. You should see that your Engineer specifies the Ideal Packless to insure quality of construction throughout.

IDEAL PACKLESS VALVE CO., WALKERVILLE, ONTARIO

The advertiser would like to know where you saw his advertisement—tell him.

BOILER ENAMEL

Is Made Entirely of Tropical Plants
No Chemicals to Injure Boilers or Fittings

Many boiler compounds are disastrous to the tubes and boiler fittings because injurious chemicals are used in their composition.

After long study we have produced this **Boiler Enamel** which **we guarantee** to remove old scale quickly, and by using small quantities in your feed water continually will prevent any new scale from forming. It is also an ideal preventive of pitting, corrosion, foaming, etc.

"Treats the Iron"

Works equally well in any class of feed water. Puts a filmy coating over the heating surfaces of the boiler and makes it absolutely impossible for solid matter in any form to adhere to the iron.

The scale forming particles in the water are affected in the same way, so cannot adhere to each other, but fall of their own weight to the bottom of the boiler, in the form of a soft, soapy mud, which will not burn or blister, and is most readily blown from the boiler.

Enormous Savings Result From Its Use

PROFIT BY THE EXPERIENCE OF OTHERS by writing us for testimonials from many well-known firms in Canada who use this boiler enamel. Their verdict will convince you that "ECLIPSE" will save money.

We don't want your money until you are satisfied with results.

WRITE FOR FULL PARTICULARS TO-DAY

W. W. CARRUTHERS

388 Edmonton Street. WINNIPEG, Man.

Sales Agent for Ontario—M. McEACHERN, 131 Montrose Ave., TORONTO

Montreal.—Paul Gariepy has had his meat market equipped with a 4-ton York refrigerating plant, installed by the Kent Co., Ltd., Montreal.

St. Johns, Que.—The ratepayers recently endorsed a by-law granting $10,000 to J. P. Mennier and J. Deneault as a bonus to a jewelry and plated ware manufacturing concern about to be started by them.

Montreal, Que.—Plans and specifications are being prepared by T. Pringle & Son, Ltd., engineers, Montreal, for extensions to reclaim plant for the Canadian Rubber Co. Montreal.

Montreal, Que.—Plans and specifications are being prepared by T. Pringle & Son, Ltd., for a new slasher house for the Dominion Textile Co., Hochelaga branch, Montreal.

Montreal, Que.—T. Pringle & Son, Ltd., are preparing plans and specifications for a manufacturing plant for the N. K. Fairbank Co., Cote St. Paul, Montreal.

Three Rivers, Que.—Plans and specifications are being prepared by T. Pringle & Son for a new cotton mill plant at the St. Maurice Valley Cotton Mills here.

Outremont, Que.—The by-law authorizing the council to borrow $400,000 was sanctioned.

Montreal, Que.—A number of Montreal capitalists are interested in the formation of the Stadacona Hydraulic Company of Quebec, whose plant at Seven Falls, near St. Anne de Beaupre, will have an initial development of 10,000 horse-power. The entire output has been sold to the Quebec Railway, Light, Heat & Power Co., and to the Bayless Pulp & Paper Co. of Penn, who are establishing a large paper plant in the vicinity. There will shortly be a public issue of bonds.

Montreal. — Engineers representing the Metropolitan Railway Company of Montreal have begun work on a system of tubes to be laid in the city. The company expects to spend one hundred million dollars on its system, which, it is said, will resemble that of New York when completed.

Montreal.—Messrs. Leonard Bros., Montreal, are making some alterations to their cold storage equipment. Mr. Charles Bishop, Montreal, is consulting engineer.

Montreal.—Messrs. John Robertson & Son, St. Catherine Street, recently installed a small refrigerating plant upon the Linde carbonic-anhydrous system, which is one of the few of this system erected in Canada. Mr. Charles Bishop, Montreal, is consulting engineer.

Montreal.—Davies, Ltd., are erecting a large cold storage building at their Montreal headquarters. The refrigeration machine contract has been awarded to the DeLaVergne Co., New York. The insulation, which will be of Nonpareil cork, has been given to the H. W. Johns-Manville Co. The low pressure machine side is being installed by the Kent Co., Montreal. Davies, Ltd., have placed the contract for the refrigerating machinery for their new Winnipeg stores in the hands of the Linde-Canadian Co., Montreal.

Montreal.—The Frontenac Brewery, Montreal, is having an extensive plant erected, and the insulation contract, which is a large one, has been awarded to the Kent Co., Montreal.

Montreal.—Progress is being made with the erection of the refrigerating plant at the C.P.R. Windsor Street Station. This work is in the hands of the Linde-British Refrigeration Co., Ltd., Montreal.

Montreal, Que.—The Montreal City Council are erecting a large central refrigeration plant at the Bonsecours market.

Ste. Therese de Blainville, Que.—The work of installing a waterworks system to cost $75,000 for the Aqueduct Company of Blainville, Blainville, Que., is being done by the owners of the company under the supervision of Engineers Ouimet and Lesage, St. Lawrence Boulevard.

NEW BRUNSWICK.

St. Johns.—The New Brunswick Cold Storage Co. has enlarged its cold storage warehouse, adding about 50 per cent. to the fish storage department and adding a chamber for the cold storage of eggs. The new storage rooms have been insulated with cork board; about five carloads of this material, it is stated, having been installed.

NOVA SCOTIA.

Prt Hawkesburg.—The Halifax Cold Storage Co. are making extensive improvements, including the addition of a 125-ton "York" refrigerating machine, installed by the Kent Co., Ltd., Montreal.

Halifax.—Messrs. Davis Fraser, Halifax, are enlarging their premises and propose to install a complete refrigeration plant. Mr. Charles Bishop, Montreal, is consulting engineer.

Prince Edward Island.—An extension of the premises of the Island Cold Storage Co., Ltd., is in hand, embodying a large complete refrigeration plant. Mr. Charles Bishop, Montreal, is consulting engineer.

CATALOGUES.

G. J. Worssan & Sons, of London, Eng., have sent us a catalogue of their "Zero" CO^2 freezing and cooling machines. The agency for these machines has been taken up by the Canada Caramel Co., 61 Dalhousie St., Montreal.

The Hill Electric Switch Mfg. Co., 65 McGill St., Montreal, have commenced the publication of a series of bulletins dealing with the lines they manufacture. These bulletins are perforated for purposes of filing. Bulletin No. 1 is descriptive of panel boards, and gives prices and sizes of all types of such equipment. They have also issued a circular on the "Ever Ready" pocket meter for testing either current or voltage. This instrument is particularly inexpensive, yet simple and accurate of construction.

Elbert Hubbard, the sage of East Aurora, has compiled a list of the world's twenty greatest men, about which he has built an essay, and refers to Joseph Dixon as "a man whose work has profoundly influenced civilization, yet, strangely enough, a man of whom the world at large knows little." This tribute to the founder of the Dixon Company is well worth reading, especially by those who wish to learn more of him, or by those who admire Mr. Hubbard's vigorous pen. Owing to a limited edition of this booklet, copies cannot be distributed except by request. The Joseph Dixon Crucible Company, Jersey City, N.J., will be pleased to honor such requests.

The Ogilvy Engineering Co. have sent us a booklet on the Maxim Boiler. This gives diagrams and illustrations of the boiler, and deals with its most prominent features. Copies of this can be had by addressing Bank of Ottawa Bldg., Montreal.

Bulletin No. 24, "The Economy Steam Turbine for Belt Drive," has just been published by the Kerr Turbine Co., Wellsville, N.Y. This bulletin shows belted economy turbine installations which are effecting marked economies over apparatus previously used.

The Skefko Ball Bearing Co., London, England, whose Canadian agents are the Engineers' Representative Co., 201 Board of Trade Building, Montreal, have issued an interesting booklet on the principle and design of the S. K. F. ball bearing, which is widely used in Europe. The bearing is of Swedish origin, and was first put on the market in 1907. It rapidly became popular, and the Swedish works have had to be frequently enlarged, until they now have a capacity of over 5,000 bearings a day. The English works commenced operations early in 1911, and have already had to be extended.

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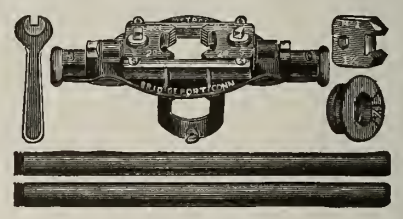

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BELTING FOR SALE—800,000 FEET OF best quality leather, rubber, hair and canvas belting, bought from bankrupt manufacturers at 25% to 75% less than the regular value. Also a large quantity of slightly used belting, piping, chains, rails, pulleys, hangers, cotton waste, etc., at very low prices. Send for catalogue. Imperial Belting and Supply Co., 5 Queen Street, Montreal.

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LAKE ERIE BOILER COMPOUND CO. REquire a few first-class representatives to sell their well-known compound. Liberal commission paid to live men, and exclusive territory. Write at once, giving references, 11 Colborne St., Toronto. (tf)

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MODERN FIREPROOF CONSTRUCTION—Our system of reinforced concrete work—as successfully used in many of Canada's largest buildings—gives better results at lower cost. "A strong statement," you will say. Write us and let us prove our claims. That's fair. Leach Concrete Co., Limited, 100 King St. West, Toronto. (tf)

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WANTED—EVERY POWER HOUSE IN Canada to remember that C. E. Shedrick, Craig Street West, Montreal, is still repairing measuring instruments, both switchboard and portable. Twenty-five years' experience in repairing all kinds and makes on the market. Intregating meters repaired, tested and sealed, and returned on quick time.

U.S. BARKEEPERS FRIEND
METAL POLISH
USED AND ENDORSED BY THE LEADING DEALERS
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Dixon's Flake Graphite No. 1.

This is the standard size of Dixon's Ticonderoga Flake Graphite, and is recommended for general lubricating requirements.

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A more finely ground graphite than No. 1, though of the same stock. This is adapted to close-fitting bearings and delicate mechanism.

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This is a selected grade of Dixon's Ticonderoga Flake Graphite ground even finer than the No. 2 Flake. It is widely used in stationary gas engines. This grade of graphite is also used on type-setting machinery.

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A strongly adhesive grease of heavy body; cannot be washed off by fresh, salt, alkaline, or acid water. Especially adapted for wire rope, gears, slides, chains, elevatorways, mining and quarrying machinery, and generally on machinery exposed to water or the weather.

"Graphite As A Lubricant," and Sample 222C free.

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As a Time, Power and Labor
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The Forbes Motor-Driven Pipe Cutting and Threading Machine

Stands alone when it comes to pipe cutting and threading.
It Saves Time: You do not have to take the work to the machine—the Forbes can be taken right to the job.
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We know you are interested in these savings—then why not get the machine that will produce them—the Forbes Pipe Cutting and Threading Machine?

Write for Bulletin giving full particulars.

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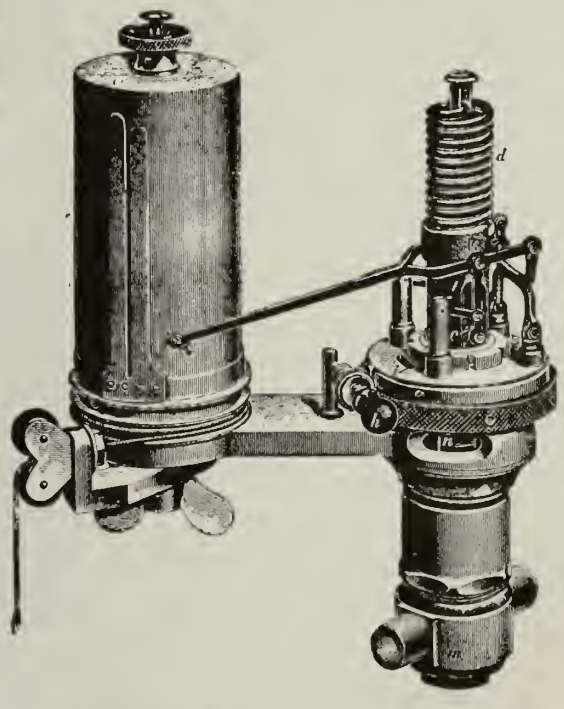

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This Indicator made in Germany is the best in the world.

Outside spring, and easily exchanged.

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Mueller Pressure Reducing and Regulating Valves

Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

DOHERTY MFG. CO., Limited
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Manufacturer for The H. MUELLER MFG. CO., Decatur, Ill., and New York City.

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FLEXIBLE STEEL

Makes Joints Quickly.

Only a Hammer Required.

No Holes to Punch.

Forms the Strongest Part of The BELT.

Let Us Send One On Trial.

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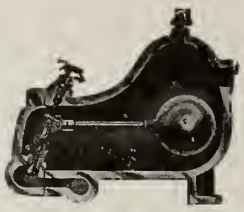
Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



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WAINWRIGHT WATER HEATERS

A Unit saved from the exhaust is worth two in the coal pile.

WAINWRIGHT WATER HEATERS
are designed specially to fulfill the requirements of Bleacheries, Dyehouses, Paper Mills, Laundries

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The only union made absolutely Non-Corrosive. Brass to iron in all contact points. Ball joint; Octagon ends, any wrench can be used. Adapted for heavy service. Every union air tested at factory. Send for circular B, describing the above and other fittings made by

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We are the largest firm in Canada making a specialty of the production of **Sanitary Cotton Wiping Cloths** by a new up-to-date process.

We are supplying the largest manufacturing plants, power houses and machine shops throughout the Dominion.

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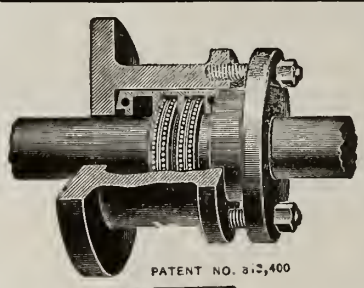

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HOLMES'
Metallic Packing
is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

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"DUNLOP"
PISTON ROD PACKING

is the best insurance against loss of power through leakages.

It expands so as to take up wear from rod, which eliminates all possibility of friction.

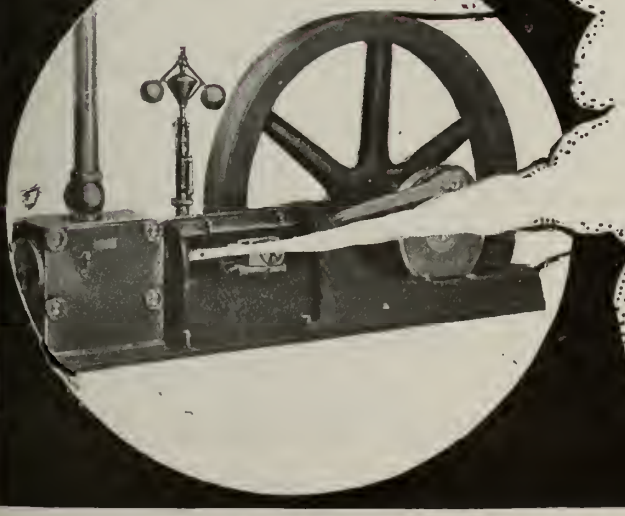
Dunlop Piston Rod Packing before pressure from the Gland is applied in the stuffing box.

No trouble will arise from being in contact with Oils, Alkalis, etc., as they cannot impair its efficiency in the slightest.

Works equally well on heavy pump and the most sensitive valve stems—no matter for what purpose, water, steam or ammonia.

Dunlop Piston Rod Packing under pressure, showing how it expands to take up wear from the rod.

We carry a large line of Packing, Belting, Hose, Valves, etc., which are backed by our "Two Hand" Trade Mark, and our reputation for superior quality.



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Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

YOU can reduce the labor and expense of boiler cleaning and cut down your consumption of fuel by using

McCOLL'S Special Boiler Compounds

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Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

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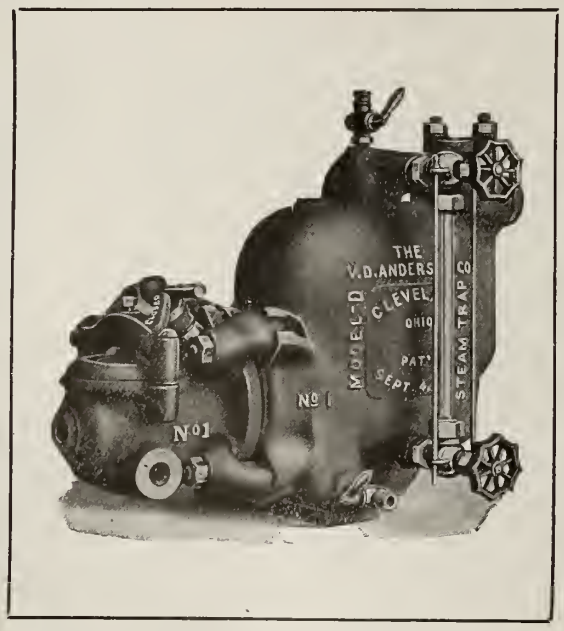
The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

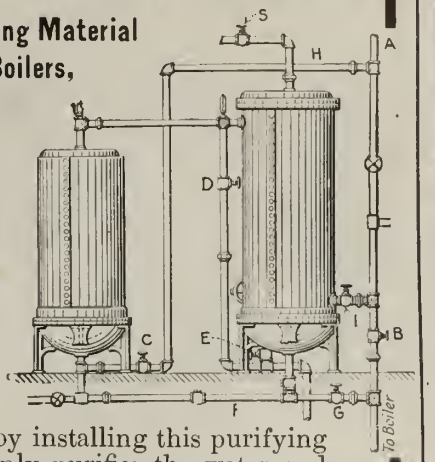
THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

The advertiser would like to know where you saw his advertisement—tell him.

The "OTIS"

Feed Water Purifying System

Keeps all Scale-making Material Out of Your Boilers,



Why be continually using boiler compounds to remove scale from your tubes? Keep this scale-making material out of your boiler altogether by installing this purifying system. It not only purifies the water and saves your boiler—it will also heat your feed water 250 to 300 degrees Fahr., and by doing this makes an enormous saving in fuel.

Let us send you full particulars of this boiler-room necessity

WRITE AT ONCE.

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So does the plant.

IF an engineer does not keep up-to-date, how long does it take to look elsewhere for a position?

IF the steam plant of any company or corporation is not up-to-date, how long does it take to find a leak?

These are not conundrums, but facts which confront us all.

The Heat and Pressure Control Co.

are experts in steam plant economics and are anxious to demonstrate what their appliances can do.

Don't fail to consult if you wish to be up-to-date in money-saving appliances.

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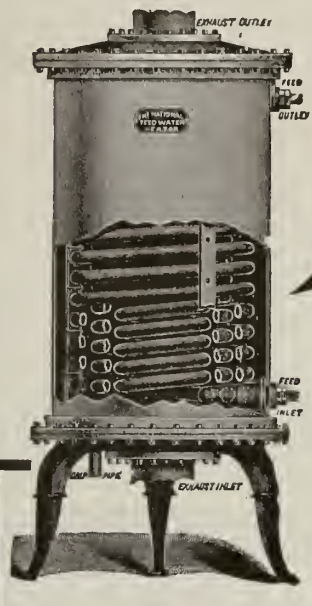
The NATIONAL FEED WATER HEATER

Reduces FUEL BILLS



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It is the SIMPLEST, yet the MOST EFFECTIVE heater made, because it has no inside joints to leak and the water does not come in contact with the shell or iron.

The "NATIONAL" absolutely ELIMINATES the possibilities of BACK PRESSURE, and will PAY FOR ITSELF many times over through the saving it incurs.

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EVERY GALLON GUARANTEED

"The choice of every engineer who knows."

Before buying your next supply of oil, write us and let us send you a sample of these high-grade oils. They are certain to give you better power transmission and add longer life to your machinery.

Send us your request to-day.

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Wholesale
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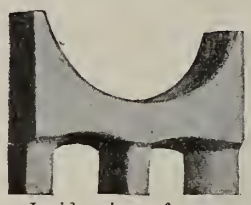
Plastic Fire Lining

The object of this plastic boiler lining is to make one solid lining having no seams or cracks to allow the waste of gas, or any leakage for air that would interfere with a perfect combustion, which by the use of this lining is a saving of fuel.

The lining is self-retaining and vitrified, and is indestructible by fire or heat.

There is no cracking or falling of walls from intense heat or cold caused by the opening of doors. Everything remains perfectly air-tight.



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After exhaustive tests we are prepared to place our plastic fire lining with you on a trial test, under a guarantee of its efficiency and savings, lasting from four to six times longer than any fire brick lining.

Let Us Tell You How

Side Walls, Bridges, whole Fire Boxes, Back Arches, or whole Settings are lined throughout, formed in one solid block with

T. T. Plastic Fire Lining.

TURNER & TUPPER
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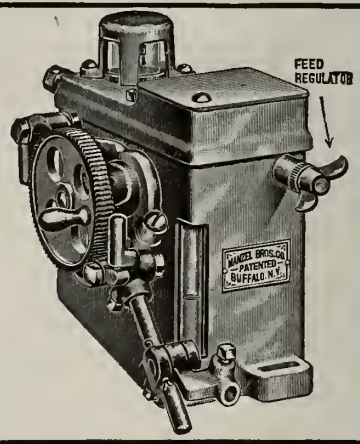
Let Us Send You a Manzel Oil Saving Oil Pump on Thirty Days' Trial

30% OIL SAVING GUARANTEED

You may be able to save as high as 60%. Many others have done so. The "Manzel" New Model Oil Saving Oil Pump is a positive lubricator. It oils the cylinders right all the time, and makes a big reduction in oil bills, besides saving labor and wear and tear on the engine.

You can try a "Manzel" Pump with the distinct understanding that it may be returned at our expense if it doesn't reduce your oil bills at least 30%.

Send for one on these conditions. Catalogue on request.



MANZEL PUMPS are carried in stock by

THE TWIN CITY OIL CO.
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Write to either of the above firms for catalog and full information. MANZEL BROTHERS CO., Buffalo, N.Y.

When All Others Fail

GERMAN VALVE CYLINDER OIL,
GERMAN ENGINE OIL,
STERLING FAST ENGINE AND DYNAMO OIL,
STERLING FRICTIONLESS COMPOUND

will cure your troubles.

Canadian Oil Companies Limited,
Toronto, Winnipeg, Montreal, St. John, Halifax, Calgary.

Detroit Lubricators are always dependable

The illustration shows Detroit Lubricator 48326, which has seen service in the electric light plant of the Bryn Mawr Real Estate Co. for over twenty-two years. The chief engineer says:

"This lubricator has been in continuous service since installation, without giving the slightest trouble or requiring any new parts whatever outside of a glass or two and an occasional washer.

"It has given complete satisfaction every day, although I suppose it has been handled by at least thirty different men. It works as well as when first put in, and will last at least as much longer.

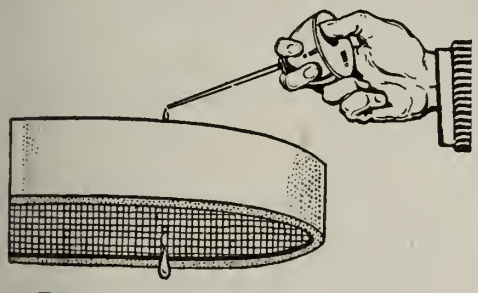
"I have always bought the Detroit Lubricator, and do not see why I should do otherwise when they all work like this one." (Fourteen Detroit Sight Feed Lubricators are employed in this plant. Some are nearly as old as the one illustrated.)

Detroit Lubricators give universal satisfaction because they can always be depended upon.

Over a million and a quarter Detroits are working to-day all over the world wherever lubricators are used, and every one is giving the kind of service that makes for the longer life and increased efficiency of the engine upon which it is installed.

Detroit Sight Feed Lubricators are dependable, because they are designed and manufactured with that idea in mind. Their economy lies in their freedom from derangements and the uninterrupted service they give, as well as in getting the greatest possible results from every drop of oil.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WINDSOR, ONTARIO



A Sieve Won't Hold Oil But It Will Hold

ALBANY GREASE

(All Lubricant—No Waste)

It is this ability to stay put that makes Albany Grease so valuable as a lubricant. Take a crankpin, for instance, where the action of centrifugal force must be overcome. Put oil in the cup and it slops and churns around, feeding continuously irrespective of the fact that at certain times no lubrication is required.

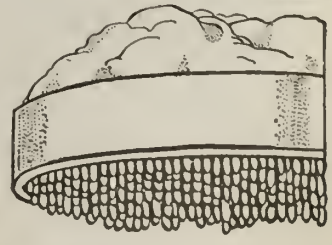
Albany Grease feeds only as the need requires. When the machinery is in motion Albany Grease flows, lubricating perfectly and reducing friction to a minimum.

Albany Grease never spatters or drips. It is not a dirty, mussy lubricant, but clean and economically efficient.

A liberal FREE sample of Albany Grease, an Albany Grease Cup and our interesting book, "Death to Friction," sent to anyone who wants to know.

At your dealer—if not, order direct.

Albany Lubricating Company
Adam Cook's Sons, Proprietors.
708-710 Washington Street, New York, U.S.A.



The advertiser would like to know where you saw his advertisement—tell him.

FIFTY PER CENT.

"PHILADELPHIA" GREASE CUP

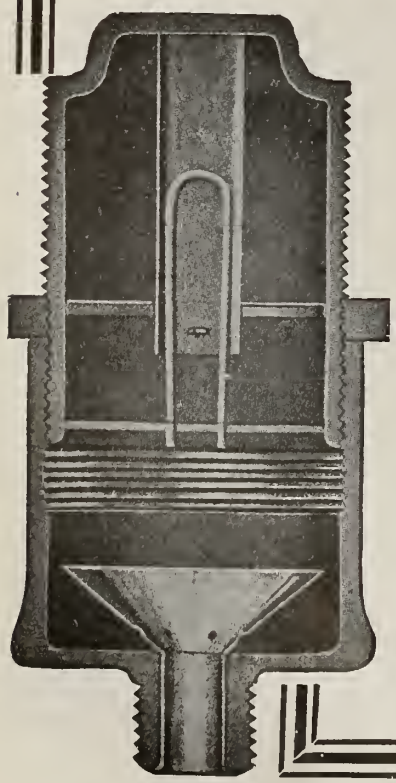
SAVING GUARANTEED

GREASE

Is Better and More Uniform Lubrication and Cheaper Than Oil

when it is properly made and used in our "PHILADELPHIA" Compressed Air Grease Cup, because there is absolutely no waste to contend with and the Grease is under perfect control until the last drop is used.

Oil used on machinery cannot be controlled, resulting in a constant dripping that means a loss of money to the user.



Why permit this loss to continue when at very little cost you can secure a perfect lubricator that will save time, money and labor—a lubricator that requires no attention after it is once filled.

The "PHILADELPHIA" efficiency cannot be affected by centrifugal force when used on loose pulleys.

Give the "PHILADELPHIA" a trial—we guarantee it to save 50% over any other lubricating system.

Write for price list and circulars.

Peterborough Lubricator Mfg. Co., Limited

PETERBOROUGH, ONTARIO

The advertiser would like to know where you saw his advertisement—tell him.

SCANDINAVIA BELTING

gives good service for use on an out-door drive.

This illustrates one drive on which Scandinavia has been in use for a long time, and is subject to all kinds of weather and atmospheric conditions.

We can save you money on Scandinavia Belting.

Federal Engineering & Supplies, Limited

Head Office, 284 Yonge St., TORONTO **Branch Office, 329 St. James St., MONTREAL**

LOOKING FOR THE "MAPLE LEAF"

is increasingly a habit with those who buy much Belting.

The reason is not hard to find, for there is no part of your Belting system, from the main drive to the smallest light Belt for power transmission, where you will not get the best kinds of service from

"MAPLE LEAF" BRAND
Stitched Cotton Duck Belting

It is the most economical Belting because it is durable under every condition; even where other Belting will deteriorate rapidly. It is water proof.

It runs absolutely true on the Pulleys.
It is built of plies of selected duck.

WRITE FOR INFORMATION AND PRICES

DOMINION BELTING CO., Ltd.

HAMILTON, CANADA

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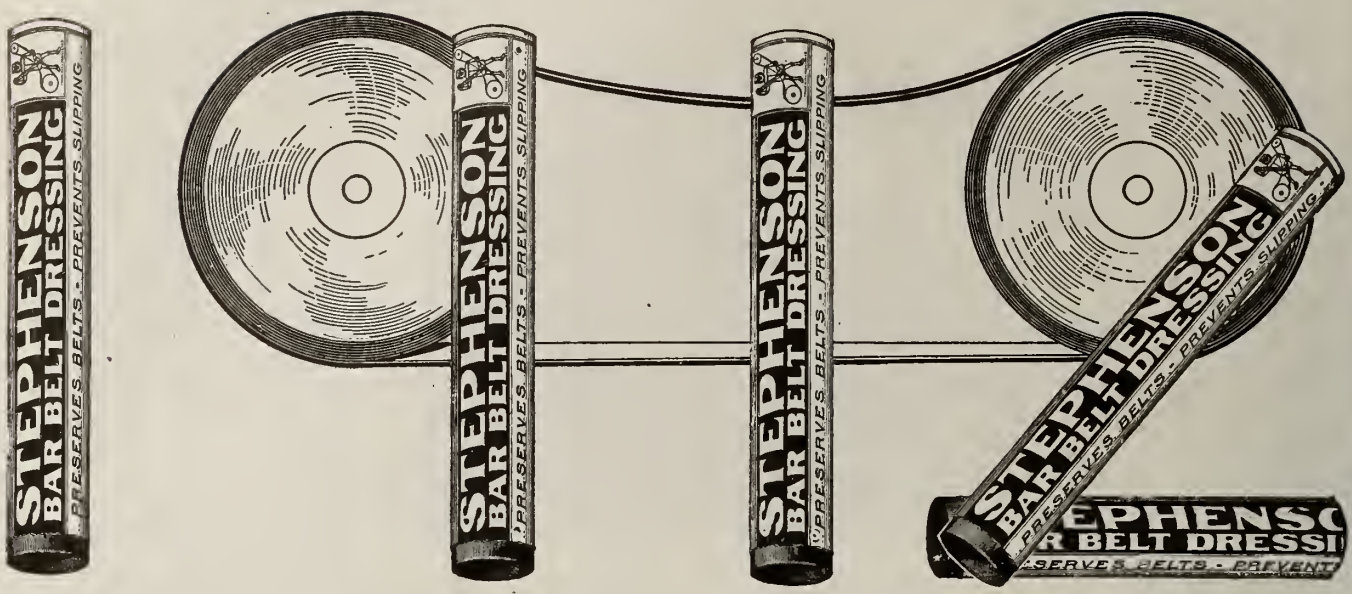
For



Use Stephenson Bar Belt Dressing

Make 1912 a record breaking year. Turn over a new leaf and get rid of the things that have been causing needless trouble and expense. Adopt the things which will make your work easier, give better results and save money for your employer. You cannot start at a better place than with your belt dressing.

Get rid of your troublesome liquid dressing. Shake the can for the Stephenson solid stick and shake trouble at the same time.

Stephenson Bar Belt Dressing is a friend in need. It doesn't require preparation, nor do you have to use special care in applying it. The minute the belt slips you hold the Stephenson bar to the belt for a few seconds and the slipping stops. There's no waste—no slop—no smearing on of paste or pouring on of spattering liquid. And the results are better.

I'll "Stick to the Solid Stick"

Start With a Free ½ Lb. Sample

Simply send us your name and address and we'll send you a present in the shape of a free half-pound sample of Stephenson Bar Belt Dressing.

Remember—we give you this sample absolutely free of charge. Get this free half-pound of the finest belt dressing made and test it. Here's your chance to try somesomething really good at no expense.

None Genuine Without Trade-Mark

Stephenson Manufacturing Company

Est. 1888 Albany, N.Y. Inc. 1897

Scientific Belt Management

This photograph shows the main driving belt, Boll Bros. Mfg. Co., Harrisburg, Pa., which has been treated with Cling-Surface since 1905, and which, in their own language, "is now as pliable as a kid glove." This is a 12 in. 8 ply leather, running from 48 in. driven pulley on 24 ft. centres. The sag is 20 in. at centre, but there is never any slip. Mr. W. A. Boll, of this firm, writes us as follows:

"Before using Cling-Surface our belts were constantly giving trouble, but after commencing Cling-Surface treatment the slip was entirely obliterated. From that time our belts have given us no trouble whatever. Cling-Surface is the best preparation we know for belts."

ALL belts in this factory are in perfect condition, pliable, clean, waterproofed and strong as ever, due to the mellowing and preservative action of Cling-Surface. Since 1905 the belt shown hasn't been shortened, nor will it need be for years to come, if ever. The cost of taking this belt up once would more than equal the cost of the Cling-Surface absorbed to date. Cling-Surface has increased the belt's life and transmission efficiency, and at the same time has effected a saving of babbitt, bearings, lubricants, fuel, labor and worry. Belts that are free from cracks and burned surfaces, that do not slip, that run as smoothly and gracefully as this, and as all Cling-Surface belts do, are a source of economy in other ways, too. Shafting and pulleys that are relieved of the strain of useless initial tension undoubtedly last longer.

Read our literature and you can easily understand WHY Cling-Surface does what it does. But no amount of reading is so convincing as a practical test. We want you to prove for yourself, at our risk, that Cling-Surface is exactly as represented.

Cling-Surface isn't offered as a miracle worker, but as a purely rational, practical and economical belt treatment. Your belts need your intelligent care. Ask for literature.

Cling-Surface Co

1057 Niagara Street Buffalo N Y

44

Merely knowing the first cost of your belting won't help you in determining your annual belting expense.

Service per dollar invested is the rock bottom basis, and

"AMPHIBIA"

(WATERPROOF)

or

"CLIMAX"

(FOR GENERAL USE.)

Leather Belting

Costs less per day of service than any other belting.

It's to your benefit to remember this.

Sadler & Haworth

Tanners and Manufacturers

MONTREAL 511 William St.
TORONTO 27 Melinda St.
ST. JOHN, N.B. 89 Prince William St.
VANCOUVER 217 Columbia Ave.
WINNIPEG 244 Princess St.

For over 35 years the makers of the best leather belts

The advertiser would like to know where you saw his advertisement—tell him.

Power Transmission Equipment and Machinery

MECHANICAL MATERIAL CONVEYORS, INDUSTRIAL RAILWAYS.
Including Rails, Switches, Frogs, Cars, etc.,

——FOR ——

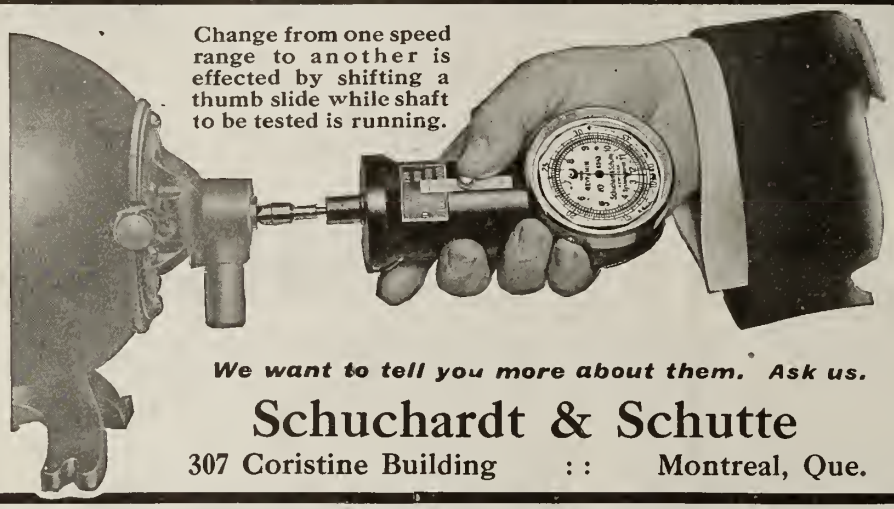
MILLS, FACTORIES, MINES, GRAIN ELEVATORS

We carry in Stock a complete line of Transmission Equipment as below.

Iron Pulleys,
Solid and Split
Sprockets,
Bearings,
Gears—Spur, Bevel, Mitre,
Shafting,
Couplings,
Post Hangers,
Post Boxes,
Take-up Boxes,
Boots,
Boot Pans,
Shaft Hangers,
Friction Clutches,
Belting,
Belt Tighteners,
Buckets,
Sprocket Chain Attachments,
Car Movers and Pullers,
Iron Work for Dumps,
Spiral Conveyors.

Equipment and Supplies for 50 Grain Elevators carried in stock at all times.
SEND US YOUR SPECIFICATIONS.

THE MANITOBA BRIDGE AND IRON WORKS, LIMITED
WINNIPEG, MAN.



Change from one speed range to another is effected by shifting a thumb slide while shaft to be tested is running.

We want to tell you more about them. Ask us.

Schuchardt & Schutte

307 Coristine Building : : Montreal, Que.

Do You Guess, or Do You Know

the capacity of your machines?

S & S Tachometers

tell you instantaneously and indicate accurately. No calculating or timing with a watch.

DEARBORN TREATMENT

is never a source of expense.

By keeping the boiler tubes and plates constantly free from scale with Dearborn Treatment, every shovelful of coal yields its utmost value, and the saving in fuel alone amounts to several times the cost of the Treatment.

Wouldn't its use mean economy to you? It is made to suit the feed water conditions at each plant and always brings successful results.

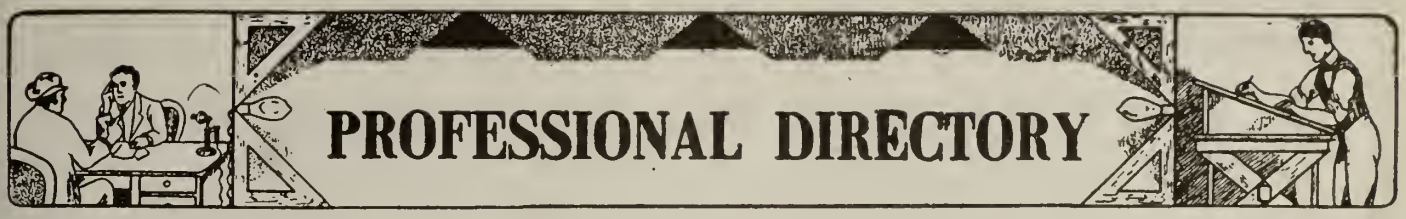
Aside from the saving in fuel there are all the benefits resulting from clean boilers—no long shut downs for cleaning, freedom from corrosion and pitting, reduced repair bills, and greatly increased life of boilers.

Send us a gallon of your feed water. We will analyze it, and advise with you regarding suitable treatment for the conditions at your plant.

Dearborn Drug & Chemical Works

General Offices, Laboratory and Works, Chicago

General Eastern Offices—299 Broadway, New York. Buffalo Office—302 Morgan Building, J. N. Gregory, Mgr.



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Indicating, valve-setting and general repairs on all kinds of engines.
RENOWN ENGINE & MACHINE CO.
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KENT BROTHERS
Miners and Exporters of
CANADIAN, AMBER MICA
Kingston Ont., - - Canada
Write us for your requirements in MICA

BAYFIELD & ARCHIBALD
CONSULTING MECHANICAL ENGINEERS
MOLSONS BANK BUILDING
P.O. Box 788 - Vancouver, B.C.

Chas. Barber & Sons
Meaford : Ontario
WATER POWER EQUIPMENT ONLY
Write for Catalogue

HAVE YOU TRIED
MONCRIEFF'S "UNIFIC"
WATER GAUGE GLASSES?
They never corrode. They last longer.
They defy competition.
For full information apply to our Canadian Representative,
W. J. WALL,
134-136 Bleury St. - Montreal

PANEL BOARDS
made by
The Devoe Electric Switch Co.
are recommended by all First Class Electrical Engineers.
Send us your specifications.
157 Craig St. West, Montreal.

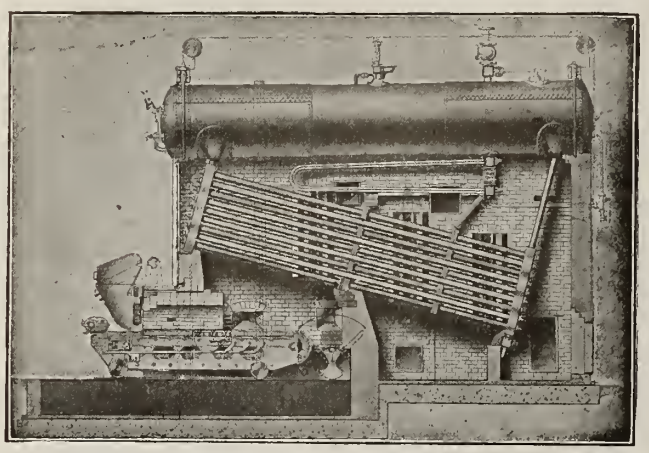
The advertiser would like to know where you saw his advertisement—tell him.

BABCOCK & WILCOX, Limited

"B. & W." PATENT WATER TUBE BOILERS

With Furnaces for all Classes of Fuel or Waste Gases

HIGHEST ECONOMY, SAFETY, DURABILITY OVER 8,000,000 IN USE



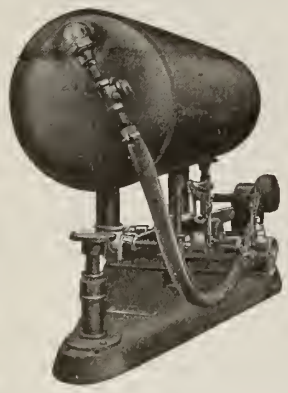
Babcock & Wilcox Patent Water Tube Boiler, Superheater and Mechanical Stoker

ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

Our Book "STEAM" sent on request

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL
TORONTO OFFICE, TRADERS BANK BUILDING



The Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars

Morehead Mfg. Co.
DEPT. "J." DETROIT, Mich.

Canadian Representatives—Geo. W. Cole, Woodstock, Ont.; H. E. Kirkham, Montreal, Que.; Park Bros., Chatham, Ont.; W. H. Rosevear & Son, Winnipeg, Man.; Robt. Hamilton, Vancouver, B. C.

WALKER'S ELECTRIC BOILER COMPOUND

Saves Money

By keeping the tubes free from scale it saves enough money in one year to pay for itself many times over.

We guarantee this compound to rid your boilers of all scale and prevent pitting, corrosion or other boiler troubles due to impure feed water.

Send us a sample of Feed Water for analysis, and get our prices.

The Electric Boiler Compound Company, Limited

Guelph, - - - - - Ontario

THE POWER HOUSE BUYERS' DIRECTORY

To our Readers:—Use this directory when seeking to buy power equipment or supplies. You will often get information that will save you money.

To our Advertisers:—Send in your name for insertion under the heading of the lines you make or sell.

To Non-Advertisers:—A nominal rate of $1 per line a year is charged non-advertisers.

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Imperial Waste & Metal Co., Montreal
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
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National Pipe Bending Co., New Haven, Conn.

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Goldie & McCulloch Co., Galt.
Canada Fdry. Co., Ltd., Toronto.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
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Waterous Engine Wks. Co., Brantford

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Goodyear Tire & Rubber Co. of Canada, Toronto.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
J. C. Wilson & Co., Glenora, Ont.

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Babcock & Wilcox, Montreal.
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Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Canadian H. W. Johns-Manville Co., Toronto.
General Machinery Co., Toronto.
Monarch Electric Co., St. Lambert, Que.
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Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Engineers' Supplies.
Jas. Morrison Brass Mfg. Co., Toronto.

Engines, Automatic and Drop Valve.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Gas and Gasoline.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto
Canadian Westinghouse Co., Hamilton.
General Machinery Co., Toronto.
General Supply Co. of Canada, Ottawa
International Harvester Co. of America, Chicago.
Keighley Gas Engine Co., Keighley, Eng.
E. Leonard & Sons, London, Ont.
John Robson (Shipley) Ltd., Shipley, Eng.

Engines, High Speed, Steam.
Canadian Boving Co., Toronto.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Marine.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
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E. Leonard & Sons, London, Ont.
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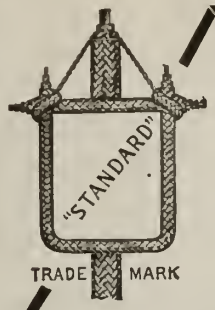

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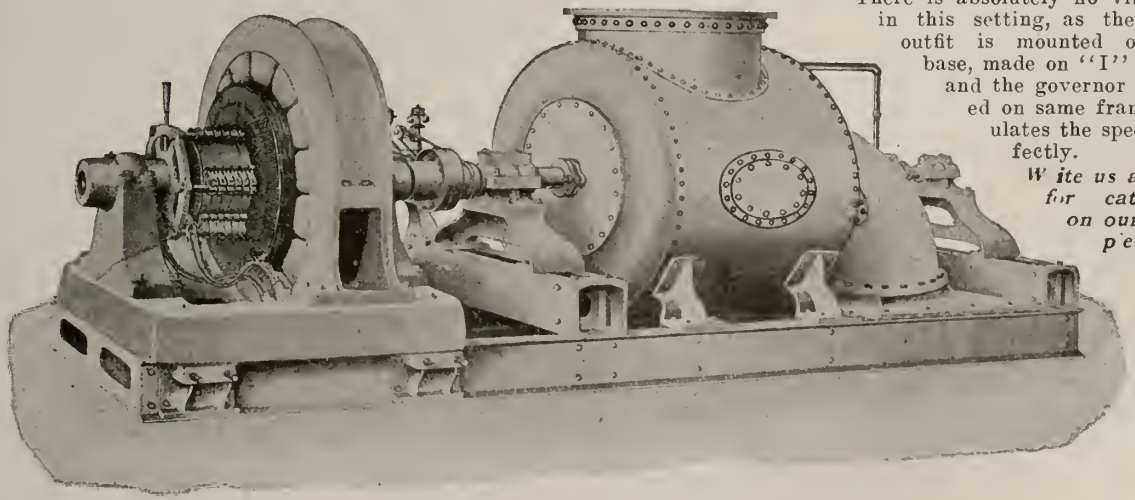

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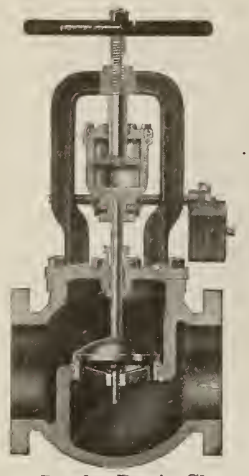

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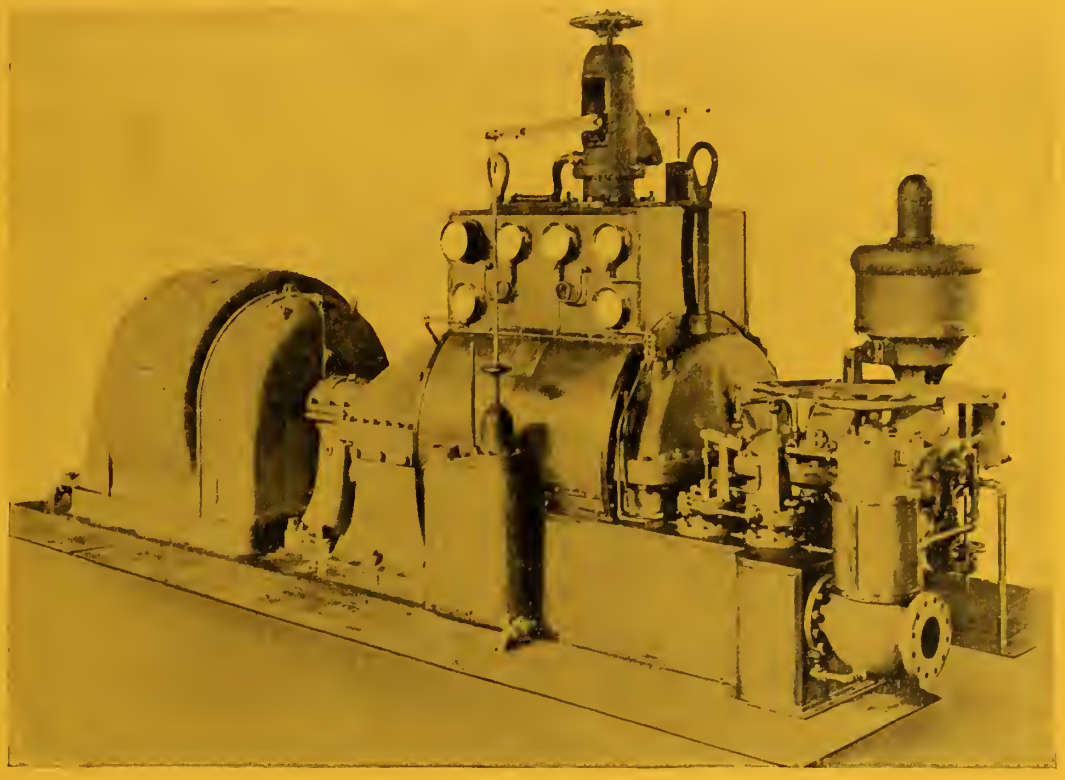

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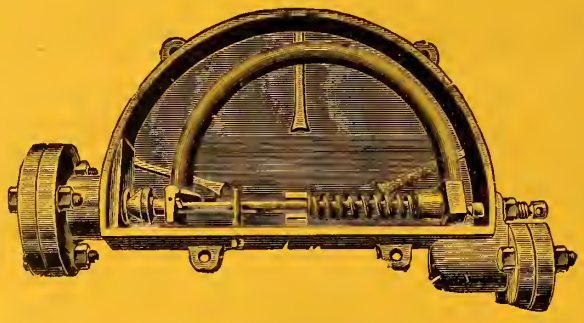

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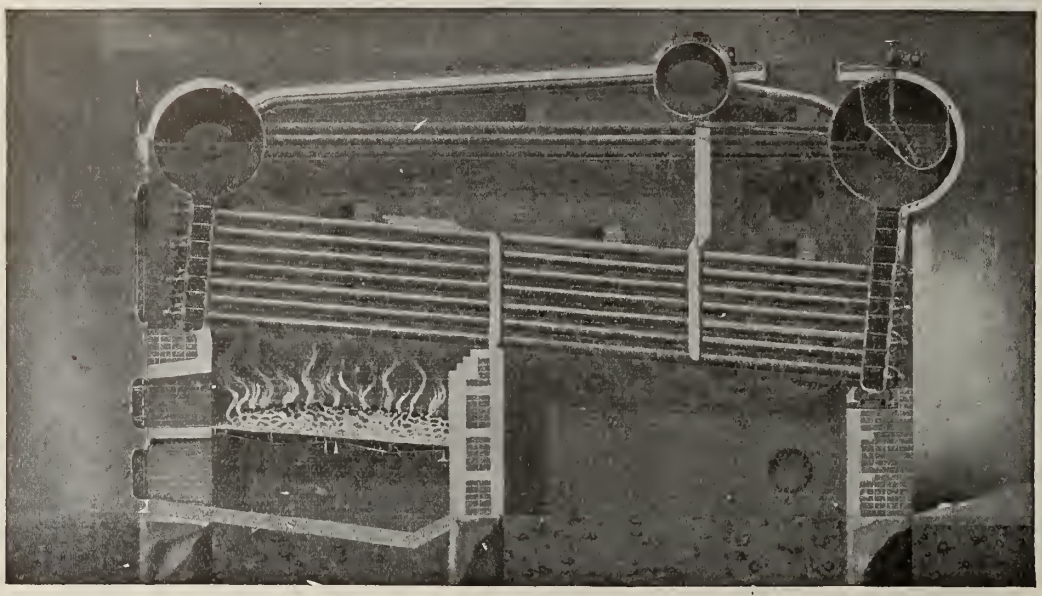

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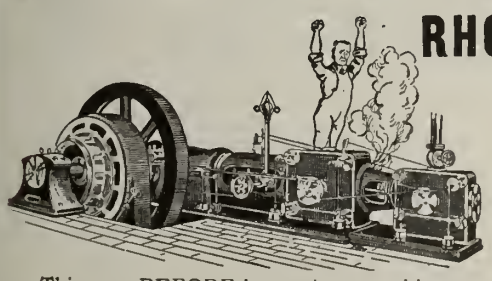
Sold on APPROVAL

RHODES IMPROVED METALLIC PACKING

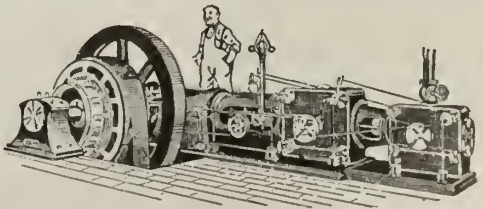


This was BEFORE he used our packing.

THE PACKING
THAT PACKS

A trial will convince you.

Beware of Imitations.



This is AFTER he installed our packing.

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited
55 St. Francois Xavier Street, - - - MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY

"Nothing to Do 'Till To-morrow"

The park is a whole lot better place to spend Sunday than is the engine room. Don't let **ordinary** rod packings make your your job a seven-day-a-week one. Thousands of your fellow engineers have ALL day Sunday to spend as they please, because they use

Daniel's Rod Packing

P.P.P.

THREE STYLES

"Regular," "Special" and "Marine." All styles are furnished in Coil, Spiral and Ring forms.

THREE rings of P. P. P. last for months. When a leak does appear, all you need do is to add another ring to the old packing, and it is good for many more weeks.

The FRICTIONLESS "give-and-take" principle upon which P. P. P. is constructed makes it both a coal and trouble saver. The finest grade lubricants are used in P. P. P. It makes rods as smooth as glass.

Use P. P. P. and the boss will notice the difference in the fuel bill, and, of course, should remember you on pay day.

FREE

TO ENGINEERS

The thousands of requests for our Engineer's Blue Book encourages us to offer an *entirely new* one, FREE.

The name of the book and a description of its contents will appear in the September or October issue of this magazine. Watch for it.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

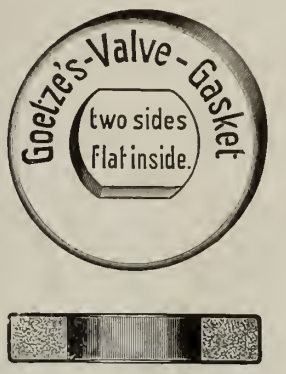
PHILADELPHIA CHICAGO PITTSBURGH NEW YORK

The advertiser would like to know where you saw his advertisement—tell him.

GOETZE'S VALVE GASKETS SAVE TROUBLE AND MONEY

THEY ARE FOR VALVES OF THE JENKINS TYPE
AND ARE MADE OF COPPER AND ASBESTOS

One Goetze's Valve Gasket will outlast six rubber discs, because it will not crack and go to pieces as rubber does. That's why Goetze's Valve Gaskets are cheapest from beginning to end.



Order your new valves fitted with Goetze's Valve Gaskets and have no more trouble with leaks. Use Goetze's Valve Gaskets to give your old valves a new lease of life. Only be sure you get *Goetze's*

That Joint That Gives You So Much Trouble Can Be Made *Tight*

To put a gasket on the least troublesome flange joint in your plant is no real test of the value of that gasket. Put it on the *worst* joint, the one that is always giving you trouble, and you'll find out whether it is any good for your purpose or not.

We tell you that you can put a complete stop to all trouble due to leaky flange joints, that you can make that joint which gives you so much trouble absolutely tight

By Using Goetze's No. 2 Gaskets

And we are willing to prove it to you by shipping you any quantity on *90 days' trial*—no charge if they do not make tight joints and ***hold*** them tight under all pressures and temperatures. Try them. Write us to-day what sizes and quantities to ship. Remember, they do not cost you a cent unless they do the work. And be sure to ask for a copy of our Illustrated Catalog of Packings for all Power Plant Purposes.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

St. John, N.B.

BRANCHES AT

MONTREAL
70 Cedar Ave.

WINNIPEG
C. E. Chown, 147 Bannatyne Ave.

VANCOUVER
A. O. Campbell, 1069 Hamilton St.

MANUFACTURED BY

Goetze Gasket & Packing Co.

NEW BRUNSWICK, N.J.

Seven Great Money-Saving Packings

Engineers and machinists throughout the Dominion are saving thousands of dollars in **time alone** by using Goodyear Packings—**short cuts to RESULTS.**

Installed quickest and most easily. **Outlast** all others. Recognized by all who **know packings** as the highest standard of excellence. Use one of these great

GOODYEAR Packings

MAGNET SHEET PACKING

Meets *every requirement*—Boiler Room or Machine Shop. Made of special compound that *resists heat*, hence the *only* packing thoroughly adapted for high pressure uses. Makes tight joint under air or hot or cold water pressure. *Unaffected* by oil, liquor, ammonia or alkali. Retains elasticity.

MAGNET GASKET TUBING

For high pressure. Like Magnet Sheet Packing, this tubing is unaffected by heat, makes tight joint, can't *blow out.* Cut any length to fit any size manhole, hand-hole, plate or pipe flange. Put up in convenient boxes with rubber core and tape.

ROUND DUCK PACKING

Fine quality cotton duck with round core. Used like Hydraulic Packing, *only for lower pressure.*

HYDRAULIC PACKING

Best packing for pump cylinders, inside-packed plungers pumping hot or cold water, and hydraulic elevators. Unexcelled for boiling water and high pressure hydraulic work.

CLOTH INSERTION PACKING

For cold and warm water pipes. Unexcelled in pliability, smoothness of finish and strength of cloth insertion. Made of heavier fabric than any other similar packing on the market.

SQUARE DUCK PACKING

Good quality cotton duck and friction to stand cold water. Cut accurately into squares.

SQUARE DUCK WITH RUBBER BACK

Specially adapted for elevator use. Made of superior cotton duck, gum back. Makes packing tight, practically no friction. Gives many times service of other packings of same nature.

VALVES

Unaffected by oil. Used in hundreds of industrial plants. Specially made to meet specific conditions.

Goodyear Packing, Belting, Hose and other rubber sundries enable you to capitalize the brains and experience of the world's greatest rubber goods experts—the knowledge and skill that underlies our reputation as well as that of the Goodyear Tire & Rubber Company, Akron, Ohio, the best known plant of its kind in the United States.

Our Sales of the last four months 50 per cent. greater than those of last year. Defective goods returned only $23.93.

Get in touch with us at once

The Goodyear Tire & Rubber Company of Canada, Ltd.

General Offices—Toronto. Factory—Bowmanville, Ont.

18 ***Write Our Nearest Branch***

BRANCHES:—Victoria, B.C. Vancouver, B.C. Calgary, Alta. Regina, Sask. Winnipeg, Man. London, Ont. Hamilton, Ont. Toronto, Ont. Montreal, Que. St. John, N.B.

TRADE THE GARLOCK PACKING CO. HAMILTON, CANADA. MARK

GARLOCK PACKINGS

On account of their superior qualities, are recognized as a standard packing for use under all conditions of service. Our Trade-mark is the passport by which we are known to those in need of reliable goods.

We have Packings to meet every requirement, and all you have to do is to write for information.

Garlock High Pressure Ring

Our handsomely illustrated catalog, descriptive of Garlock Packings and Pipe Coverings will be mailed on request.

Garlock Asbestos Gasket

"POINEERS IN THE PACKING BUSINESS."

The Garlock Packing Co.

Head Office and Works: HAMILTON, ONT.

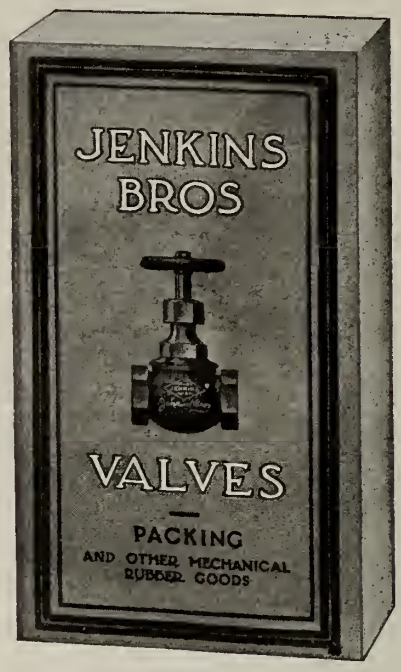
Branches: MONTREAL, QUE., 412 St. James Street.
TORONTO, ONT., 77 Adelaide Street East.
WINNIPEG, MAN., 117 Market Street East.

TRADE JENKINS MARK
Jenkins Bros

Here's a Catalog

You Ought to have—

The new Jenkins Bros. Catalog for 1912



It shows some new types of valves, including the new TYPE "K" brass and iron body gate valves; cast steel valves of extra heavy patterns for superheated steam and hydraulic service, extra heavy check and blow-off valves, automatic equalizing stop and check valves, additional styles of radiator valves—

As well as the standard Jenkins Bros. types you have known and used for years.

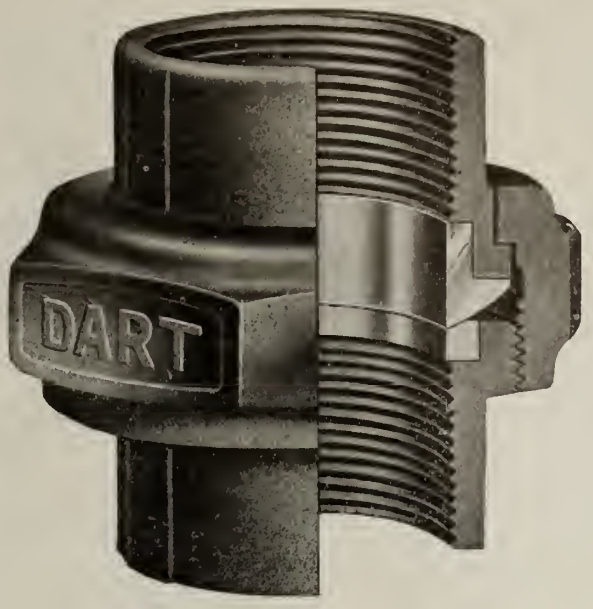
Compact—handy—brimful of information for the man who's interested in valves, packing and other mechanical rubber goods for the power plant.

Send for your copy to-day.

Jenkins Bros., Limited

103 ST. REMI STREET

MONTREAL



Only a Union pipe coupling, BUT

It is one of those little items, like the flea on the dog, that worries. A little bother and a little expense now and then to keep the unions tight does not seem much, but in the total it is another tale.

The union coupling with the name "DART" cast on it, if used to connect your pipes, will positively eliminate all those worries.

Dart Unions stay tight and never require attention. They may be connected time after time and are not affected by expansion, contraction or vibration.

Made in a factory where nothing else is manufactured. Made right, heavy in design and to exact standard.

They have iron thread ends, with a bronze to bronze ground ball joint that makes the connection whether pipes are in or out of line, and will not rust or corrode.

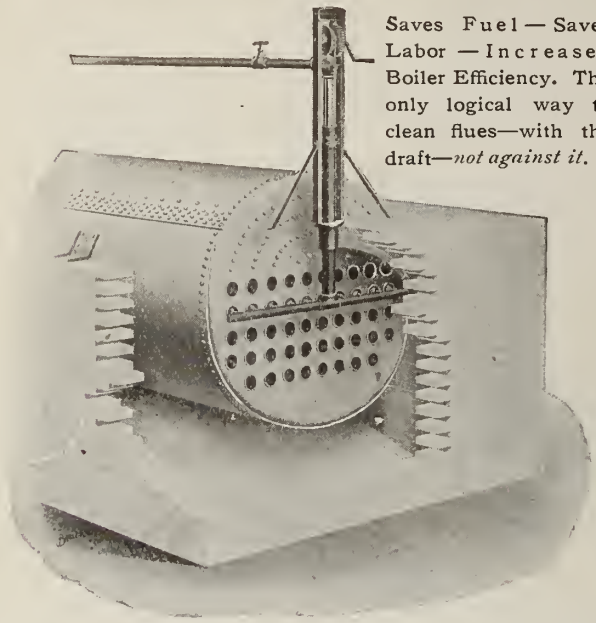
You are guaranteed absolute satisfaction with Dart Unions. Any failing to satisfy will be replaced two for one.

Sold by Jobbers Everywhere

DART UNION CO., Ltd. TORONTO

BRONZE TO BRONZE

'THE HENRY' STEAM FLUE CLEANER



Saves Fuel — Saves Labor — Increases Boiler Efficiency. The only logical way to clean flues—with the draft—*not against it.*

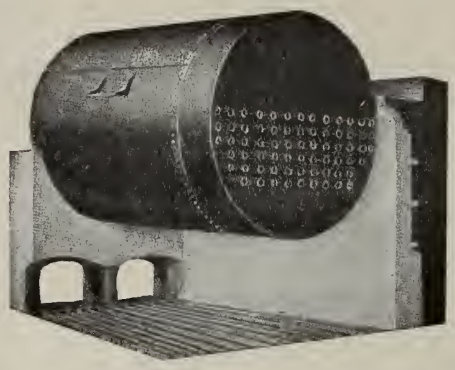
Write to nearest Representative for Catalog and Particulars.

THE STEAM APPLIANCE CO.
MILWAUKEE, WISCONSIN.

Western Agent:
CANADA SALES CO.
Donalda Bldg. Winnipeg.

Eastern Agent:
ENGINEERS REPRESENTATIVE CO.
201 Board of Trade Bldg. Montreal.

The Plastic Fire Lining

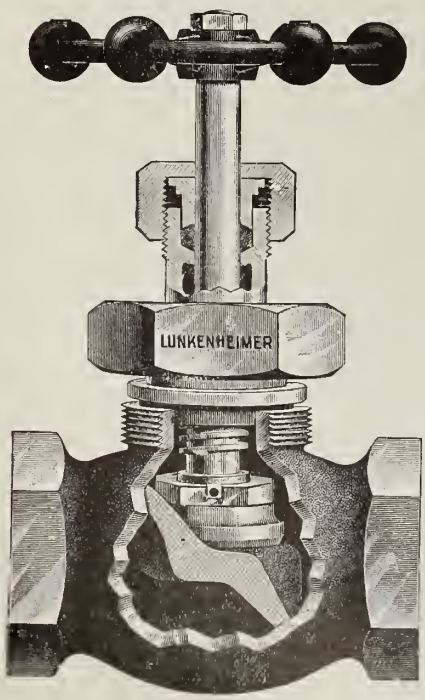


Door Arches and Whole Front — in one block.
Side Walls, or both in one block.

These linings do not expand or contract and there are no brick or mortar joints to work loose.

They are readily installed by anyone and require no special moulds or forms. Let us tell you how.

The Turner & Tupper Co.
Rear 58 Peter St.
TORONTO ONTARIO



LUNKENHEIMER REGRINDING VALVES

These valves have invariably maintained a reputation for quality of the very highest, and justly so, because they are **absolutely dependable,** are made of the **best grade** of **only new material,** and by **skilled mechanics,** in the shops of **The Lunkenheimer Company,** whose reputation for quality is universally acknowledged.

They require no extra parts when the seating faces are worn. They can easily and quickly be reground, making them as tight as when new, and this process does not necessitate the removal of the valves from their connecting pipes.

The union connection between the body and hub permits the valve to be quickly and easily taken apart for regrinding or repairs, and also protects the uniting threads from the corroding action of the steam.

LUNKENHEIMER REGRINDING VALVES can be packed under pressure when wide open, and the areas throughout the bodies are largely in excess of the nominal diameter of the connecting pipes.

The valves are made in two styles—one with **Inside Screw** and the other with **Outside Screw and Yoke,** and in two weights—**Medium Pattern,** for working pressures up to 200, and Extra Heavy for pressures up to 300 pounds.

Your local dealer can furnish them. If not, write us.

Write for 1912 catalogue.

THE LUNKENHEIMER COMPANY
Largest Manufacturers of High Grade Engineering Specialties in the World.

General Offices and Works: CINCINNATI, OHIO, U.S.A.

NEW YORK	CHICAGO	BOSTON	LONDON, S.E.
64-68 Fulton St.	186 N. Dearborn St.	138 High St.	35 Great Dover St.

3

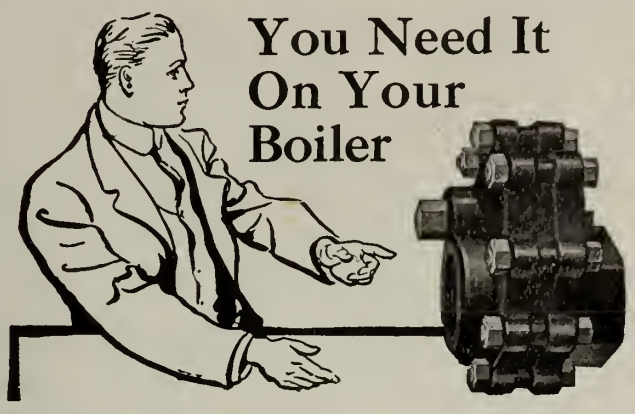
The advertiser would like to know where you saw his advertisement—tell him.

A GOOD INVESTMENT

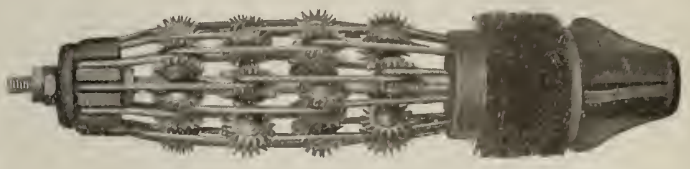
IS MONEY SPENT IN KEEPING THE BOILERS CLEAN

HERE ARE TWO OF THE BEST MEDIUMS

"EVERLASTING" BLOW-OFF VALVE—THE "FLEXIBLE" TUBE CLEANER



You Need It On Your Boiler



The "FLEXIBLE" Tube Cleaner does a better job with half the labor. It rolls through the tube. Sent on trial if desired.

Engineering Specialties Company

1080 King Street West — **TORONTO, ONTARIO**

H. L. PEILER & CO., 380 St. James Street, Montreal

AGENTS:

THE A. R. WILLIAMS MACH. CO. OF ST. JOHN, N.B., LTD., St. John, N.B.

P. D. McLAREN, LIMITED, Calgary, Alta.

HOMESTEAD
STRAIGHTWAY VALVES

ALWAYS OUTLAST OTHER VALVES

For Pressure Up to 5000 lbs. per. Sq. In.

The reason is very evident.

Where the common Globe and Gate Valves have their vital parts—the seats—exposed to pressure and constant wear, every minute they are open, the seat of the Homestead Straightway is never exposed.

The plug is balanced and held in place by the pressure when open, and when closed it is locked in the seat by our patent wedging cam, insuring freedom from friction in the seat while the plug is turning and making the Homestead the quickest acting, the simplest, the most easily operated and the most durable valve known.

Let us send full details. Write

Homestead Valve Mfg. Co.

PITTSBURG, PA.

The Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars and a Trial Trap.

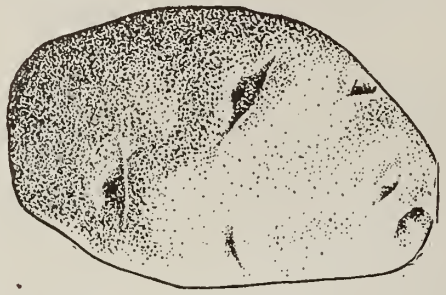
Canadian Morehead Mfg. Co.

WOODSTOCK, ONT.

The advertiser would like to know where you saw his advertisement—tell him.

Potato Scale Boiler Cleanser

"A DEADLY ENEMY OF SCALE"



We absolutely guarantee this Boiler Cleanser to remove all old scale, and if a small quantity is used continually, it will prevent any new scale from forming.

The composition of this Cleanser is of such ingredients that it is harmless to metal.

Send us a gallon of feed water and we will mix a quantity for **free trial** to suit your water conditions.

Write to-day.

C. C. Snowdon, Wholesale

P. O. Box 1384 - - CALGARY, ALTA.

Cut Down Your Fuel Bills

AND INCREASE YOUR PROFITS BY USING

WALKER'S ELECTRIC BOILER COMPOUND

The Effective Scale Remover

We guarantee this compound to rid your boilers of all scale and prevent pitting, corrosion or other boiler troubles due to impure feed water, without the slightest injury to tubes or fittings. A scale free boiler requires only a minimum amount of fuel, whereas a boiler that has a coating of scale on the tubes requires extra fuel to make the required amount of steam pressure. Examine **your** boilers. Perhaps they are causing you unnecessary expense.

Send us a sample of feed water for analysis, and get our prices.

The Electric Boiler Compound Company, Limited

Guelph, - - - - - Ontario

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

W. A. CROCKETT

Executive Secretary

MT. HAMILTON, - - ONTARIO

TIMES CHANGE

So does the plant.

IF an engineer does not keep up-to-date, how long does it take to look elsewhere for a position?

IF the steam plant of any company or corporation is not up-to-date, how long does it take to find a leak?

These are not conundrums, but facts which confront us all.

The Heat and Pressure Control Co.

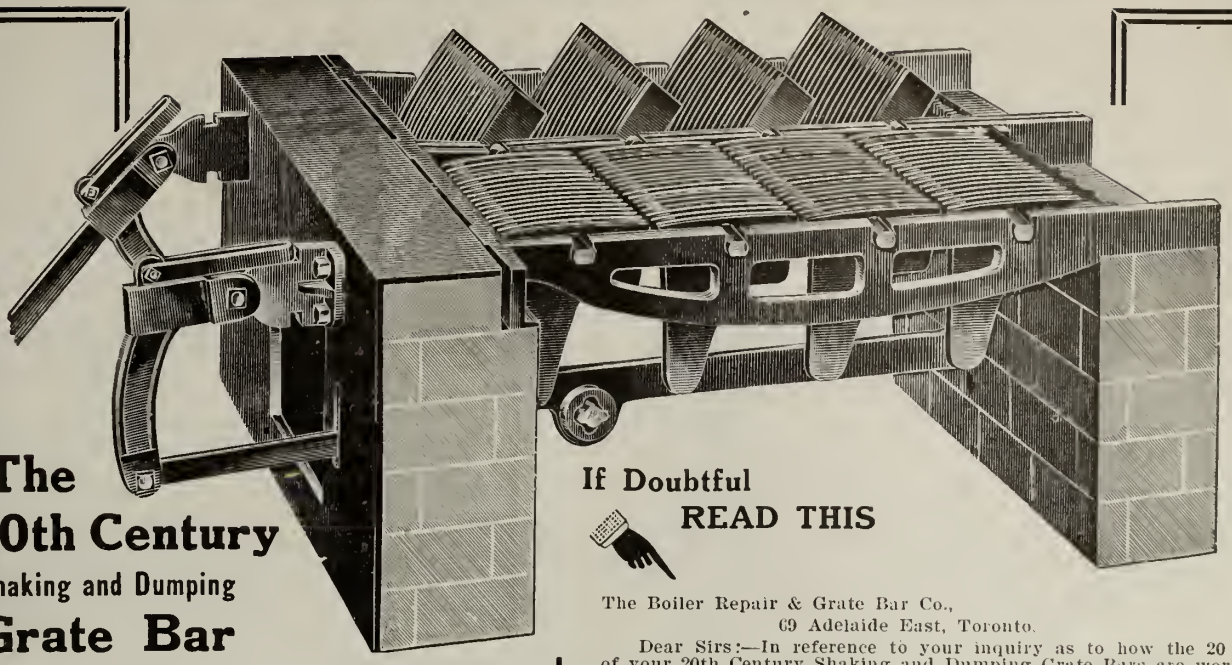
are experts in steam plant economics and are anxious to demonstrate what their appliances can do.

Don't fail to consult if you wish to be up-to-date in money-saving appliances.

WRITE OR CALL

603 Kent Building - - Toronto

SEE OUR GRATE BARS AT TORONTO EXHIBITION



The 20th Century Shaking and Dumping Grate Bar

Saves Money, Saves Worry and Fuel, Lasts Longest, is Self Cleaning, and makes more Steam.

Write For Full Particulars.

If Doubtful READ THIS

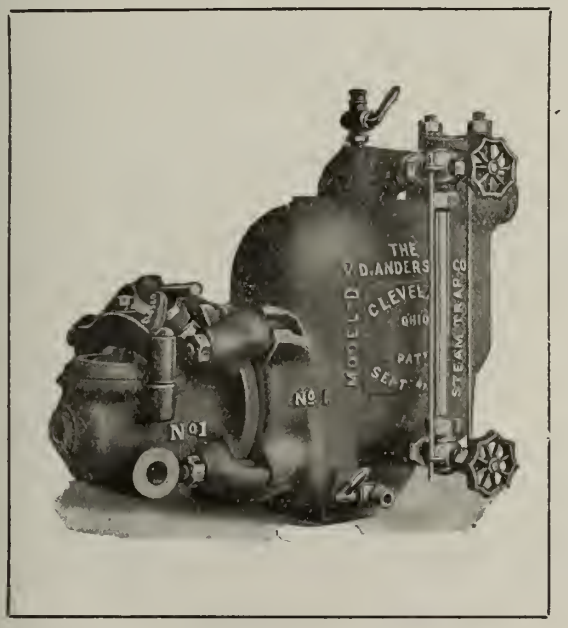
The Boiler Repair & Grate Bar Co.,
69 Adelaide East, Toronto.

Dear Sirs:—In reference to your inquiry as to how the 20 sets of your 20th Century Shaking and Dumping Grate Bars are working in our kilns. As you know, we have had several different makes installed but we consider that your Bar is the best Shaking and Dumping Bar in the market to-day, in the way of economy of fuel, ease of operation and durability, and we gladly recommend it to all whom it may concern.

(Signed) BELL BROS. & CO.,
per GEORGE BELL.
480 Greenwood Avenue, Toronto.

The Boiler Repair & Grate Bar Co.
69 Adelaide Street East, TORONTO

The Anderson Model "D" Steam Trap



IT IS ALL that its name implies—a trap for Steam from which steam never escapes, and the water of condensation invariably does.

Should your Anderson Model "D" Trap be arranged to work from 30 lbs. pressure down, and you wish to use it at pressure from 150 lbs. down, it is only necessary to remove the valve and seat and insert new ones suitable for the higher pressure.

This can be done in five minutes without breaking a steam joint or pipe connection.

We carry in stock, and can furnish at once, valves and seats which will work successfully at any specified pressure.

Combine this feature of flexibility with its great capacity and durability, and you will understand why the "Anderson" is recognized as the ideal steam trap for draining heating systems, coils, etc., of all condensation without interruptions or waste of steam.

Made in seven sizes.

THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

Would you like to Spend your Sundays at Home?

Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

YOU can reduce the labor and expense of boiler cleaning and cut down your consumption of fuel by using

McCOLL'S Special Boiler Compounds

or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

WRITE FOR PARTICULARS TO

McCOLL BROS. & COMPANY

Montreal, Toronto, Winnipeg or Vancouver

DEARBORN TREATMENT

by its remarkable RESULTS

has convinced the industrial world that the remedy for boiler feed water troubles lies in scientific analysis and special treatment for each individual case.

Dearborn Treatment is to ordinary "boiler compounds" what eminent scientific diagnosis and prescription is to quack nostrums and "cure-alls."

Dearborn Treatment is based upon expert, scientific analysis of a sample of the boiler feed water you are using. The analysis, tests, and compounding of the correct remedy are conducted in the largest, most modern, and thoroughly equipped laboratories and manufacturing plant devoted to the science of water treatment, in existence.

Dearborn Treatment gives you the benefit of the world's largest existing fund of data relating to water treatment.

Gallon sample of water required for analysis.

Dearborn Drug & Chemical Works

General Offices, Laboratory and Works, Chicago

General Eastern Offices—299 Broadway, New York. Buffalo Office—302 Morgan Building, J. N. Gregory, Mgr.

The advertiser would like to know where you saw his advertisement—tell him.

Disastrous To Scale, But Harmless To Metals

BOILER ENAMEL

Many well known firms in Canada who use this Boiler Enamel will gladly testify as to its real value. We will submit names on request.

If you are not now using this scale remover and preventative **you cannot afford to overlook our trial offer.**

We claim that **"Eclipse"** will remove all **old scale** quickly, and by using small quantities in your feed water continually will prevent any new scale from forming. It also prevents pitting, corrosion, foaming, **and will save money.**

"Eclipse" Boiler Enamel must come up to these claims before you pay a cent.

"Eclipse" works equally well in any class of feed water.

Write for full particulars at once.

Remember, it is absolutely guaranteed.

W. W. CARRUTHERS

388 Edmonton Street, WINNIPEG, MAN.

Sales Agent for Ontario—M. McEACHERN, 131 Montrose Ave., TORONTO

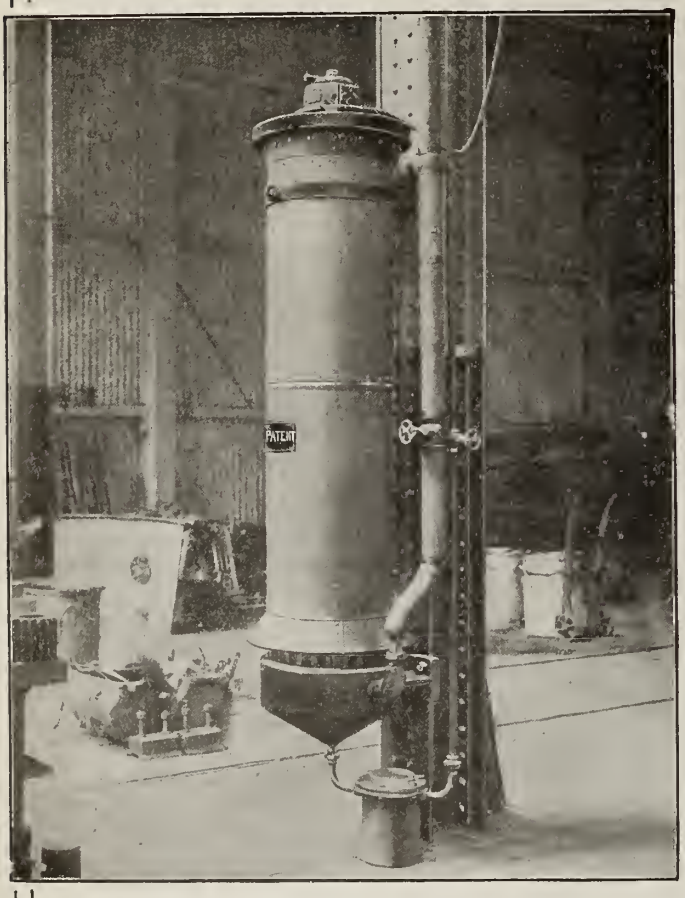
Ventilating a Valuable Fact

A Subject of Vital Importance to Your Business

It is a well established fact that a man working in a properly heated and ventilated shop can accomplish far more than the same man working in a poorly heated and ventilated shop. He can do more, and do it better, and stands a bigger chance of doing it day in and day out.

THE STANLOCK SYSTEM of Heating and Ventilating

Inexpensive at the start and completely satisfactory in use. Adopted by many leading engineers and big manufacturers in this country and Europe.



The System

This system consists of units as shown below. They are made of steel tubes screwed into circular cast iron bases and through these tubes steam passes. Enclosing these tubes is a sheet metal cylindrical casting with a motor at the top. The air is forced downwards, thus keeping the floor warm. A special pipe can be fitted, passing through the roof or through the side wall, thus giving a supply of fresh air. Dampers are provided so that the inside air can be circulated or outside air can be taken in and heated. Can be installed in old or new buildings.

Its Advantages

1. No overhead air ducts are required.
2. No underground masonry ducts are required.
3. No obstruction to light due to overhead air ducts.
4. No heat losses due to radiation from air ducts.
5. Minimum of power absorbed.
6. Units hung on walls. No floor space needed.
7. Various units operated independently and can be turned on or off like radiators. Some supply fresh heated air and others merely circulate and heat.
8. A unit using 60 lb. steam pressure heats 3,600 sq. ft. of floor space.
9. The first cost of apparatus is very low.
10. Units may be added at any time in case of extensions, and in case of boiler shops, units may be removed entirely during the summer months, if desirable.

IT WILL PAY YOU TO ASK US FOR COMPLETE INFORMATION AND AN ESTIMATE ON YOUR REQUIREMENTS. DICTATE A LETTER TO-DAY

THE GARTH COMPANY

Sole Canadian Agents

26-32 Craig Street, Montreal

Do You Know to a Pound How Much Coal Your Boilers Burn?

Don't You Want to Know?

FAIRBANKS' SUSPENSION COAL SCALE
Montreal Tramways & Power Co., Limited

Not knowing, to the pound, how much coal your boilers burn, how can you determine with any degree of accuracy the efficiency of your boilers? The true energy-producing quality of your coal? The cost of your power?

We show here a one ton Fairbanks' Suspension Coal Scale, with quick weighing dial, installed in the Power House of the Montreal Tramways & Power Co., Limited. With this scale they can check to a pound the amount of coal the boilers use.

The scale hopper is mounted on a trolley which runs on a track in front of the boilers and this trolley is operated by means of a motor controlled from the floor below. The scale hopper is filled from the overhead coal bunkers, the coal weighed, and the trolley is then run along the track until it is opposite the boiler you desire to feed. There the coal is dumped into the feed hoppers of the automatic stokers.

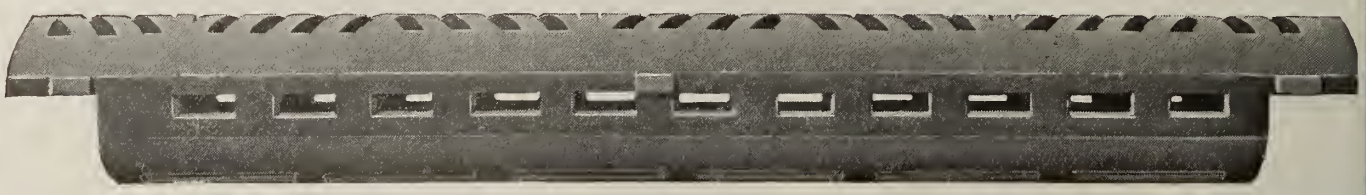
This scale should be in every up-to-date power house. It can be adapted to meet your requirements. Let us know what the conditions are in your power house. Write for further particulars.

The Canadian Fairbanks-Morse Co., Limited

FAIRBANKS' SCALES—FAIRBANKS' VALVES—FAIRBANKS-MORSE GAS ENGINES, SAFES, VAULTS, Etc.

Montreal St. John Ottawa Toronto Winnipeg Saskatoon Calgary Vancouver Victoria

THOMAS ELLIPTIC GRATE BARS



Are Doing This For Others—Why Not You?

BIRMINGHAM RAILWAY, LIGHT & POWER CO.

Thomas Grate Bar Company, Birmingham, Ala. Birmingham, Ala., June 22, 1912.

Gentlemen:

We have been using your grate bars for the past thirty days, burning a mixture of coke and coke braize. Since installing your bars we have dispensed with forced draft, and I would say we are getting 15 per cent. increase with less fuel since we only have to clean the fire about one-half as many times as previously.

Yours truly,
L. G. GREER, Superintendent Gas Department.

PEOPLES COTTON OIL COMPANY

Thomas Grate Bar Company, Birmingham, Ala. Selma, Ala., July 22, 1912.

Gentlemen:

Your letter of recent date to hand, in reference to your grate bars. In reply wish to say that the THOMAS ELLIPTIC GRATE BARS are all that you claim for them. On account of the oval shape of the bar it automatically sheds its ash and makes much less clinker, and will burn the coal much cleaner than the old style bars. Your grates have much more air space area than the ordinary grates, and cost no more than ordinary grates.

We put in two sets last season on trial and one more set this season, which speaks for itself as to our opinion of your bars.

Yours truly,
PEOPLES COTTON OIL COMPANY,
(Signed) J. S. BUTLER, Supt.

SHREVEPORT, ALEXANDRIA & SOUTHWESTERN RAILWAY SYSTEM.
Operating Sibley, Lake Bisteneau & Southern Railway Co., Woodworth and Louisiana Central Railway Co., Louisiana & Pacific Railway Co.

Thomas Grate Bar Company, Birmingham, Ala. Woodworth, La., July 22, 1912.

Gentlemen:

We have been using your Thomas Elliptic Grate Bars for the past two years, and have no hesitancy in stating to you that we consider them the best bars we have ever used. I do not hesitate in stating to you that since installing your bars, we have been using less fuel, with at least 25 per cent. better results. We have, also, done away with our force draft, and can heartily recommend the Thomas Elliptic Grate Bars to any one where they are short of steam and fuel is an object.

Yours truly,
(Signed) ROBT. STACK, General Superintendent.

SEND US YOUR ORDER

THEY SAVE YOU MONEY

Cost less by lasting longer. Make more steam by increasing combustion. Save fuel by better burning the gases. Save labor by reducing fuel and cleaning.

PROOF—A Test Set—Then 2nd, 3rd, 4th, 5th, 6th, 7th, 8th Repeat Orders.

The General Supply Co., of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

Thomas Grate Bar Co., Birmingham, Ala., U. S. A.

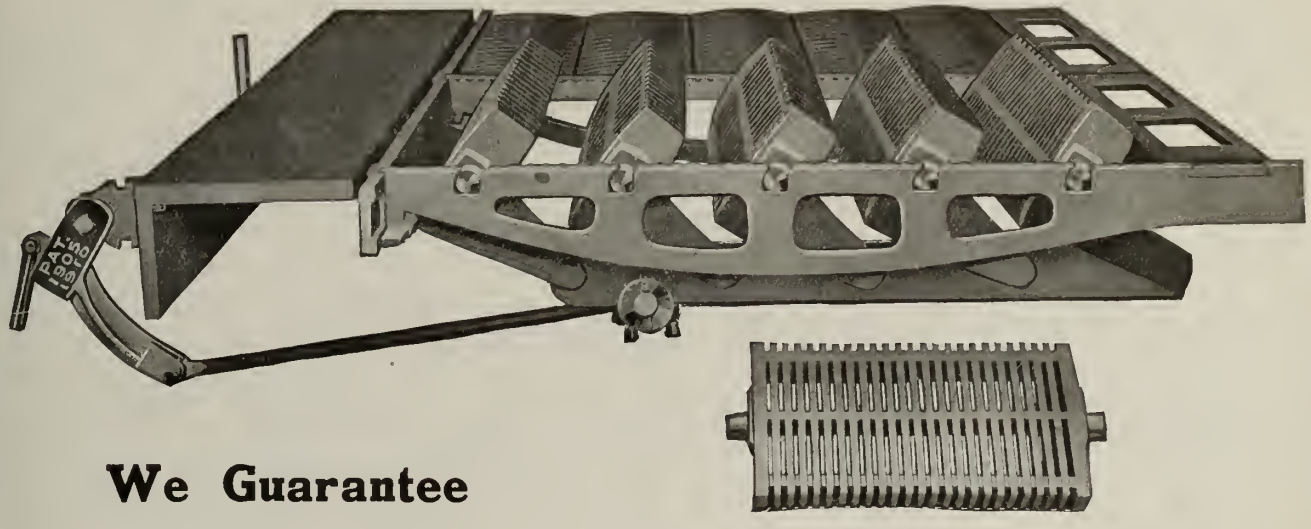
SAVE FUEL and LABOR

By Installing the

"THE Cyclone"

Shaking and Dumping Grate Bar

It Has Many Imitators — Beware of Them



We Guarantee

That with the "CYCLONE" SHAKING AND DUMPING GRATE BAR any grade of hard or soft coal, or screenings of same, can be burned with excellent results as regards economy and capacity, and that the total annual expense to the purchaser for interest, depreciation, shut-down, etc., will be much less than will be the case with any other type of grate on the market.

We install on 30 DAYS' free trial.

We are prepared to install our Grates in the plant of any reputable company on thirty days' trial, leaving it to the purchaser to say if the grate is or is not satisfactory at the end of that period.

If it should not be absolutely satisfactory we will remove the grate from the premises without cost to purchaser, or without causing loss through shut-downs while doing so.

Write for circulars and complete description.

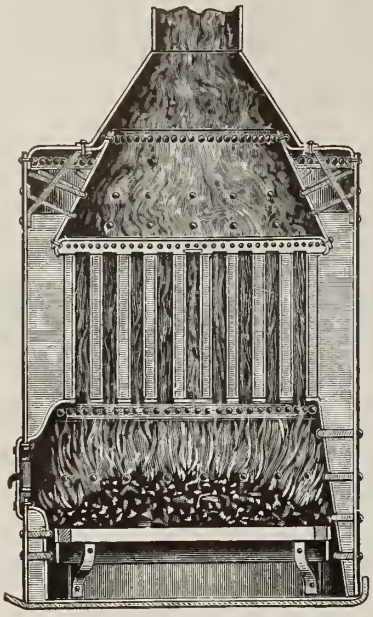
CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST - - - - TORONTO, CANADA

AGENTS

ST. JOHN, N. B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.



Marine Boilers

We build various types: Scotch, Clyde, Fitzgibbon, Vertical, Mosher.

Land Boilers

Horizontal, Tubular, Vertical, Locomotive Type, Water Tube, "Heine."

GENERAL PLATE WORK

THE BEST MATERIAL, MANIPULATED BY EXPERIENCED WORKMEN, ENSURES A FIRST CLASS BOILER.

We Employ Both. ***Consult Us.***

POLSON IRON WORKS, LIMITED

STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

TORONTO **CANADA**

REPRESENTATIVES IN CANADA FOR

The B. F. Sturtevant Co., Hyde Park, Mass., U.S.A., Fans, Blowers, Heating and Ventilating
The John I. Thornycroft Co., London, England, Marine Motors

THE MURPHY AUTOMATIC SMOKELESS FURNACE

If you operate a steam power plant it may be interesting to you to learn that you can **increase capacity from boilers** about 25 per cent., **decrease cost for power** about 20 per cent., **lessen labor costs in boiler room** and **eliminate the smoke nuisance.**

In "The Power House" we have given new commercial facts each month—experience of Canadian users with Murphy Furnaces. In one instance where the saving in coal, alone, was at the rate of $27,000 a year, on an investment of about $15,000, and was followed by three repeat orders in seven years for 2,000 H.P. additional Murphy Furnace equipment.

The **business proposition for you to consider is** "What will be the dividend earning power of the money investment required for Murphy Furnace equipment?" You can hold a five-cent piece so close to the eye as that you can't see dollars within arm's reach.

Murphy Furnaces may not—in your opinion—be good enough for you, but the following well-known Canadian Manufacturers **know,** by reason of experience, **their value:**

SHERWIN-WILLIAMS CO., Montreal, P.Q.—
9 years' experience, 2 repeat orders, 4 furnaces, ... 600 H.P.

LAURENTIDE PAPER CO., Grand Mere, P.Q.—
7 years' experience, 3 repeat orders, 14 furnaces ..... 4,375 H.P.

OWEN SOUND PORTLAND CEMENT CO., Shallow Lake, Ont.—
7 years' experience, 1 repeat order, 5 furnaces ..... 770 H.P.

MANSON CAMPBELL CO., LTD., Chatham, Ont.—
6 years' experience, 1 repeat order, 2 furnaces ..... 330 H.P.

CANADIAN LOCOMOTIVE WORKS, LTD., Kingston, Ont.—
6 years' experience, 1 repeat order, 4 furnaces ..... 1,000 H.P.

ST. LAWRENCE STARCH CO., LTD., Port Credit, Ont.—
4 years' experience, 1 repeat order, 4 furnaces ..... 860 H.P.

HARRIS ABATTOIR CO., LTD., Toronto, Ont.—
3 years' experience, 1 repeat order, 3 furnaces ..... 750 H.P.

BELGO-CANADIAN PULP & PAPER CO., LTD., Shawinigan Falls, P.Q.—
2 years' experience, 2 repeat orders, 5 furnaces ..... 1,375 H.P.

TORONTO CARPET MFG. CO., Toronto, Ont.—
1st order 1911, 3 furnaces, 446 H.P.;
2nd order July, 1912, 3 furnaces, 425 H.P.; 6 furnaces ..... 871 H.P.

For printed matter address

MURPHY IRON WORKS, DETROIT, MICH. BUFFALO, N. Y.

"Bennis" Machine Stokers making cheap steam.

The Boiler Houses of Canada.

It must be admitted that these do not compare very favorably with those of Great Britain. It is the *exception* in the latter country to hand-fire boilers; it is the *rule* in Canada. Canada has yet to appreciate the fact that machine-firing, provided the right machine is chosen, has been lifted from the region of speculation to that of certainty. The installation of "Bennis" machine stokers is an investment that pays for itself.

In the leading boiler houses of Great Britain the name of "Bennis" is recognized as readily on stoking plants as the image and superscription of His Majesty on the golden coin that all the world honors.

Consider for a moment what "Bennis" machines effect: They mean **cheap steam**; they are great on economy—clear strong fires without smoke, from low-grade coals; increased boiler-duty without damage to the boiler; low maintenance costs, and, as they are practically automatic in action, minimum labor costs.

Write or apply for "Boiler House Economy" Pamphlets to

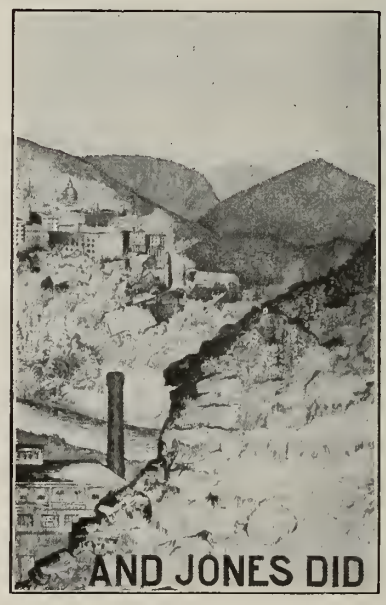
GEO. H. TOD, 213 Manning Chambers, Queen St. West, **TORONTO**

JONES UNDERFEED STOKERS

will "STOP" the smoke from your chimney and at the same time save you 15 to 20 per cent. in fuel bills over "good" hand firing!

We guarantee our improved equipment as installed to-day and will demonstrate a definite saving to any power plant owner in Canada!

If we do not save the **coal** it will **cost you nothing!**



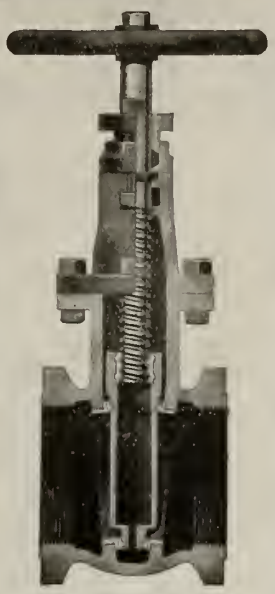
JONES UNDERFEED STOKER CO., Limited

NATIONAL TRUST BUILDING

TORONTO

The advertiser would like to know where you saw his advertisement—tell him.

6 inch Screwed Iron Body Gate Valve



6 inch Interior Veiw of I. B. B. M. Gate Valve

KERR

IRON BODY

GATE VALVES

The above illustrations are of the new **"KEYSTONE"** pattern gate valve which we are now shipping to our customers, and which is being so favorably commented upon by all who have as yet seen them, owing to their modern equipment and strong compact design.

See that

KERR

is on the body of the next valves you buy.

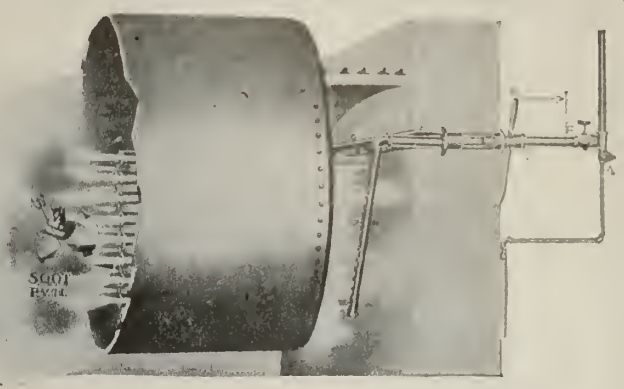
Specify them, and you'll get them.

The Kerr Engine Co.

LIMITED

WALKERVILLE - - ONTARIO

MORE STEAM



The Vulcan Cleaning a Return Tubular Boiler

LESS COAL

KEEP THE SOOT OUT OF THE BOILERS WITH THE

VULCAN SOOT CLEANER

You'll get more steam and you'll save 5 to 10% on your coal bill.

The difference between a clean heating surface in your boiler and a dirty one, is often the difference between dividend and deficit. It is the daily operating cost of a boiler that counts. If the boiler tubes are coated with soot you face a drop in capacity and a **big loss in efficiency.**

The profit lost through a dirty boiler would pay for a Vulcan Soot Cleaner many times over. The Vulcan will produce a saving for you the same as it does for others. It is the **modern** way of handling the soot problem.

Soot defies removal by hand blowing. The Vulcan scours the tubes as clean as gun barrels—removes all soot in a few minutes—no shut-downs—no time waste—no dirt—no trouble—no air leakage—nothing but complete satisfaction and results.

We send the cleaner on 30 days' free trial—return it if you don't like it. We won't get "sore" nor try to force the cleaner on you. **IT'S UP TO YOU.**

Return the coupon and get our trial proposition and a free copy of "Economical Steam Production," a complete and pointed discussion on soot and how to get rid of it.

Cleaning Water Tube Boilers is also OUR SPECIALTY

Vulcan Tube Cleaning Systems

LIMITED

42 Craig St. West, MONTREAL.

---------SIGN, TEAR OUT AND MAI ---------

Power House, June 12. *Date*.....

Vulcan Tube Cleaning Systems, Limited.
42 Craig St. West, Montreal.

Please send me without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.
(It is important that following information be given in full.)

Water Tube Boilers. Number.....Type.....Pressure.....
Horsepower.....No. Tubes High (except on Stirling boiler .....
Any Superheaters.....Width of alley space at side.....
Tubular Boilers. Number.....Horizontal or vertical.....
Name.....
Address.....

The advertiser would like to know where you saw his advertisement—tell him.

Power House Equipment

If you want to Buy, Sell or Exchange

CONSULT US ON

POWER HOUSE APPARATUS

Air Compressors
Alternating Current Generators, belted
Alternating Current Motors
Arc Dynamos
Arc Lamps
Boilers
Booster Sets
Condensers
Direct-Connected Units
both alternating and direct current
Direct Current Generators, belted
Direct Current Motors
Electrical Instruments
Engines
Feed Water Heaters
Hoisting Equipment
Motor Generator Sets
Pumps
Rotary Converters
Switchboards
Transformers
Turbines, both steam and water.

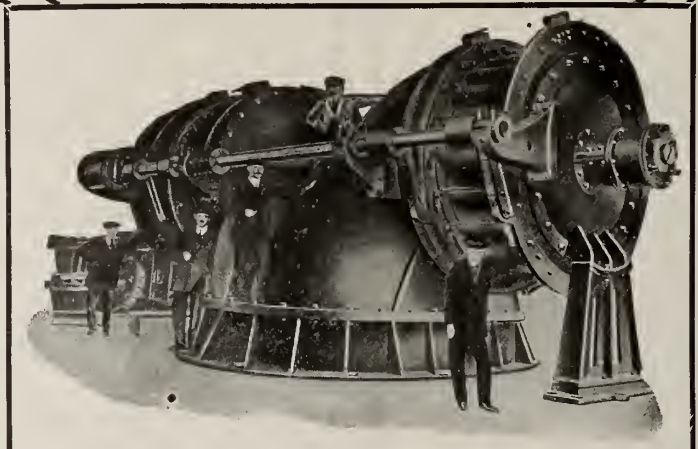
WE ARE THE MEN BETWEEN.

Railway Equipment Company of Toronto, Limited
1240-1250 Dundas Street, TORONTO, ONT.
Phone Junction 1247

WATER TURBINES
—AND—
GOVERNORS

All Sizes

Maximum Efficiency

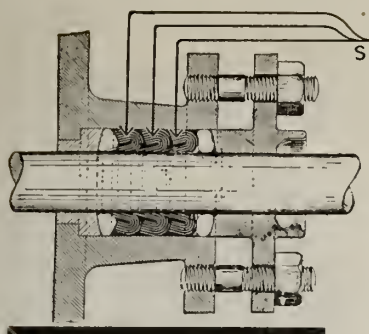


All Heads

Ideal Control

ASK FOR PARTICULARS FROM
THE CANADIAN BOVING CO., LTD.
164 BAY STREET, TORONTO.
Branch Office for British Columbia, 427 Seymour St., Vancouver

The advertiser would like to know where you saw his advertisement—tell him.



An Automatic Rod Packing That Combines Economy with Efficiency

The problem of eliminating waste of power resulting from the packing of a gland or stuffing-box has long been a serious one. Until the advent of J-M Sea Rings, this vital problem remained unsolved.

Ordinary "soft" packings exert a pressure or friction on the rod at all times on both strokes because the packing must always be screwed up tight to prevent leakage.

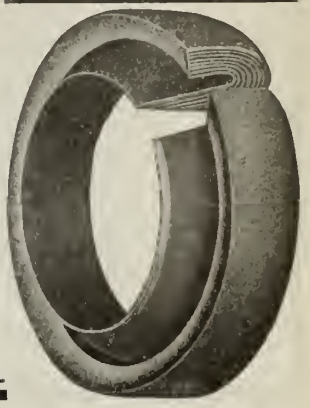
This results in a needless and extravagant expenditure of power, as the piston rod, during the forward stroke of an engine, is subjected to unnecessary pressure by the packing.

J-M SEA RINGS

reduce this pressure to a minimum. Being automatic or self-setting, the friction created is never greater than that absolutely necessary to prevent leakage. This effects a considerable saving in fuel consumption and also adds greatly to the life of the packing.

J-M Sea Rings are durable and self-lubricating—they will outwear all ordinary packings. They will withstand all steam and hydraulic service, and the highest temperatures and pressures.

J-M Sea Rings are easily applied, and guaranteed to give the highest efficiency in their respective uses.



Write nearest Branch for copy of our "Blue Book" which fully describes this wonderful packing.

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED

Manufacturers of Asbestos and Magnesia Products

TRADE ASBESTOS MARK

Asbestos Roofings, Packings, Electrical Supplies, Etc.

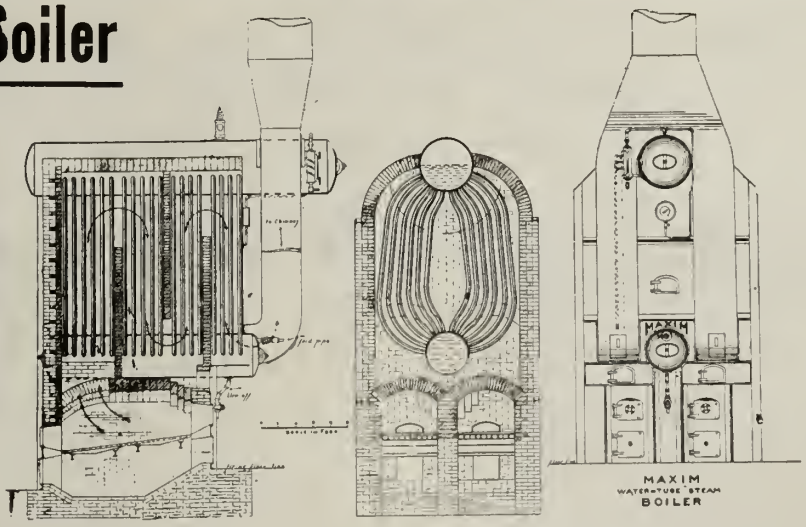
1546

TORONTO MONTREAL WINNIPEG VANCOUVER

The Maxim Boiler

Do you understand the purpose of a feed water heater? Well, have you used an economizer? If your boiler carries steam at 100 pounds pressure, the temperature of the steam (and therefore the water in the boiler) is 338 degrees. If you get your waste gases down to 500 degrees you are doing well. This is where an economizer comes in. The waste gases are carried through it and their temperature reduced, maybe by 150 degrees. The feed water is passed through the economizer, going in at maybe 80 degrees and out at 200. THE MAXIM BOILER INCLUDES AS ONE OF ITS PARTS AN ECONOMIZER, and we have cases where the owners report the flue gases reduced to below 300 degrees.

THE ALISON ECONOMIZER IS ARRANGED AS PART OF THE MAXIM BOILER. It is the most effective economizer made. It makes the Maxim Boiler more economical than any other.



Report of test of two 250 H. P. Maxim Water Tube Boilers at works of the Keystone Watch Case Co., Philadelphia:

Average Temp. Feed Water, 62.5 degrees Fahr.

Average Temp. of Steam, 357 degree Fahr.

Average Temp. Escaping Gases, 312 degrees Fahr. Highest, 370 degrees, Lowest, 280 degrees.

Fuel, No. 2 Buckwheat or Rice Anthracite.

Quality of Steam, 99.5 per cent. dry.

EQUIVALENT WATER ACTUALLY EVAPORATED FROM AND AT 212 DEGREES PER POUND OF COMBUSTIBLE, 12.177 LBS.

The above test was made by the owners of the plant.

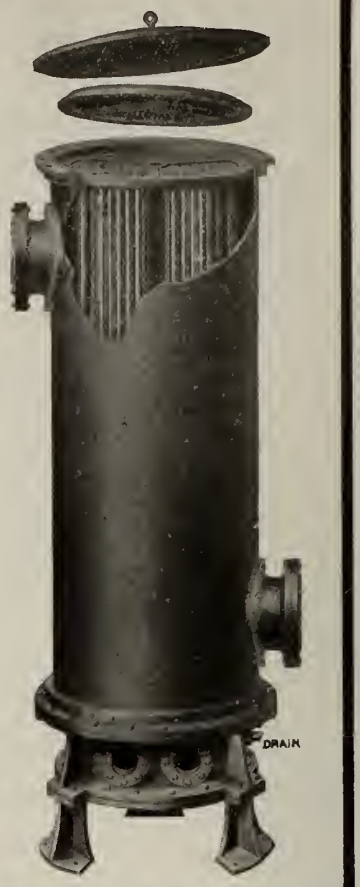
Maxim Tubes do not work loose, and Maxim Boilers make better use of the fuel than is possible with other boilers. MAXIM BOILERS ARE ECONOMICAL ALL THE TIME.

Ogilvy Engineering Company, Bank of Ottawa Building, Montreal

PRACTICAL TESTS HAVE PROVED

THAT THE

"SIMS" TUBULAR FEED WATER HEATERS



Heat the Water Hotter, Remain Clean Longer, and can be Cleaned Easier than any Other Make.

The "SIMS" Feed Water Heater has been designed after a careful study of other Heaters, particularly noticing the defects and making it a point to cover them.

Circulation of water through Heater, although apparently ignored by most makers, is a factor of such vital importance that it must be reckoned with to secure the best possible results.

The "SIMS" circulation is rapid and perfect. It stands in a class by itself for durability and economy.

Write for descriptive catalogue at once.

THE SIMS COMPANY, - - Erie, Pa.

CANADIAN REPRESENTATIVES:

H. L. Peiler & Co:, 380 St. James Street, Montreal, Que., and 69 Adelaide Street West, Toronto, Ont.

You can change the grade of coal without getting a new grate. Simply take off the detachable tops and put on new tops having correct air openings

Macdonald Shaking Grate

You save in repair expense for you don't need to replace the whole grate simply because a small part is burned out.

More air—better combustion with this shaking grate, for with the same motion of the operating lever the points penetrate into the fuel about twice as far as with other types.

ASK FOR BULLETIN NO. 4.

ROBB ENGINEERING COMPANY, LIMITED

AMHERST, N. S,, CANADA — SOUTH FRAMINCHAM, MASS.

DISTRICT OFFICES:

Canadian Express Building, Montreal - R. W .Robb, Manager
Traders Bank Building, Toronto - William McKay, Manager
Union Bank Building, Winnipeg - W. F. Porter, Manager.
Grain Exchange Building, Calgary - J. F. Porter, Manager

Sole Canadian Agents for C. A. Parsons & Company, Turbines, Turbo Pumps, Blowers, Compressors, etc.

39-28

The advertiser would like to know where you saw his advertisement—tell him.

Simplicity and Durability

are the principles upon which every

"NATIONAL" FEED-WATER HEATER

is built. It is so simple that it cannot get out of order—so durable that it assures the longest and most economical service.

The "NATIONAL" has no inside joints to leak; no straight tubes to leak; no back pressure is possible. No contact of water with shell or iron. No chance for grease in boiler.

—It saves fuel, time and labor—
—Write for catalog and price—

The National Pipe Bending Company

91 Lloyd Street, New Haven, Conn., U.S.A.

WE SELL RELIABLE ENGINEERING SPECIALTIES AND SERVICE

Bundy Steam Traps

with the enviable reputation of the most efficient trap **service** in the world, bar none.

Mason Regulators

No other line of regulating devices carries such a pure record of **service rendered.**

Ashton Valves

The **service** of Ashton Valves is not approached by any other.

Sims Feed Water Heaters

The heater with the record of maximum **service** per dollar invested.

We are prepared to prove the above to your complete satisfaction—will you ask us ?

H. L. Peiler & Company

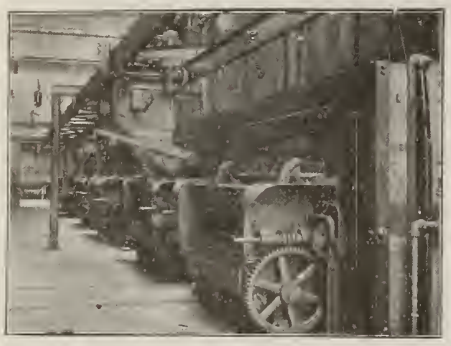
TORONTO
69 Adelaide St. E.

MONTREAL
380 St. James Street.

MONCTON, N.B.
MacLeod Bldg.

The Scientific Handling of Coal and Ashes in Power Plants

not only eliminates the heavy drudgery and hand labor method, but actually increases the service of the plant.



Jeffrey Traveling Scale Hopper delivering coal from bin to stokers.

Jeffrey Coal and Ashes Handling Systems

are moderate in first cost, superior in service, require minimum space for operation, and are built to meet all conditions.

The coal is removed from railroad cars by Jeffrey Grab Bucket System and delivered to storage bin or direct to boiler room, where it is crushed and delivered into an overhead bin.

Catalogue No. 32 shows the wide adaptability of Jeffrey Systems to Power Plant Service. Write for copy.

JEFFREY MFG. COMPANY

Canadian Main Office and Works, Montreal
Winnipeg Representatives, N. J. DINNEN & COMPANY

FLEXIBLE INTERLOCKING METAL HOSE

For Conveying Steam, Air, Gas, Etc.

This metal hose is made in either steel or copper and is just as light and flexible as rubber.

It will not kink, burn out or rot, and will give real service under all conditions.

Its lasting qualities are many times greater than those of rubber and there is practically no cost of maintenance.

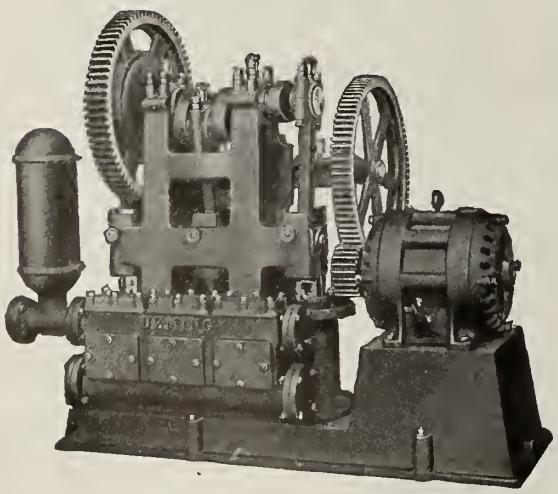
Our prices are right. Get our circulars NOW.

The Metallschlauch-Syndikat
PFORZHEIM, BADEN - GERMANY

F. J. SCHUCH
19 Jarvis St. - Toronto, Canada
(Canadian Agent)

DEMING TRIPLEX PUMPS

Deliver an EVEN, STEADY STREAM



GENERAL SERVICE DEMING TRIPLEX POWER PUMP FOR OPERATION BY ELECTRIC MOTOR.
Made in all sizes.

One plunger is always on the downstroke.
This maintains an unwavering pressure.
Liquids flow from the discharge pipe in a steady stream, free from pulsations.
No jerky action to wear out the motor.
Made also for operation by belt and gas or gasoline engine.
Tell us under what conditions your pumps will have to work.

The Deming Company
Salem, Ohio :: U.S.A.

Hand and Power Pumps for all Uses

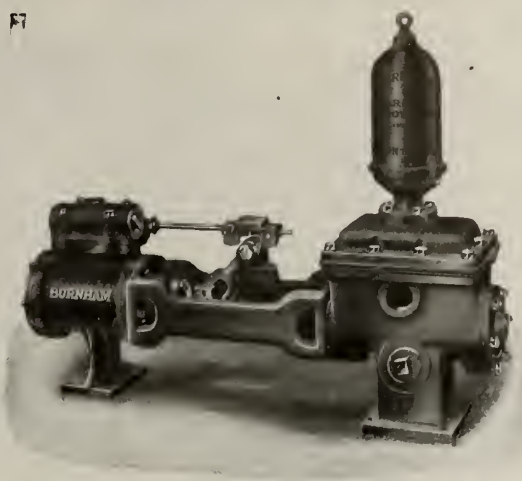
GENERAL AGENTS:

DARLING BROS., 303 Owena St., MONTREAL

BURNHAM STEAM PUMP

Of the thousands of steam pumps installed every year, a large percentage of them bear the name of "Burnham," the **Steam Pump** endorsed by leading Architects, Consulting Engineers and Heating Contractors as the best, simplest and most economical pump on the market.

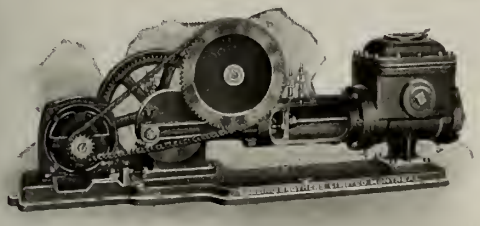
If you want a pump for handling hot water, use the "Burnham."



Burnham Boiler Feed Pump.

Thousands of Burnham pumps are in operation in connection with **Vacuum Heating Systems**; they are specially adapted for this service. Standard Burnham Boiler Feed Pumps and Burnham Vacuum Pumps are kept in stock and can be shipped promptly.

Ask for Catalogue "P."

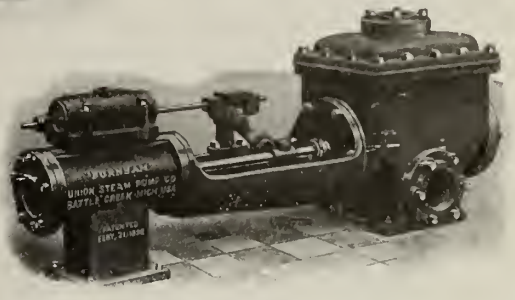


Union Electrically Driven Vacuum Pump.

Darling Brothers,
LIMITED

15 Ottawa St., Montreal.

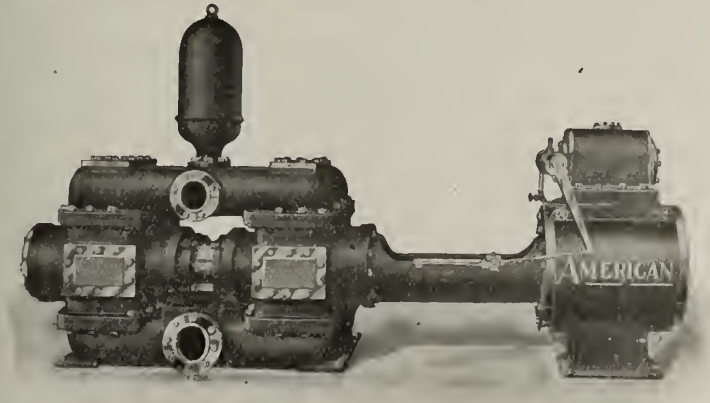
Toronto, Winnipeg and St. John.



Burnham Vacuum Pump.

American Steam Pumps

Reputation built on Quality not Cheapness.



A WORD AS TO CONSTRUCTION

Phosphor bronze wearing parts throughout, including water bushings, piston rods, stuffing boxes and valve seats. Heavily constructed water ends built amply strong to withstand any unforeseen strain.

NOTICE THE STEAM END

No slide valves to wear. Steam valve of the balanced piston type. The feature in the American Pump that appeals to engineers is that the steam end wears as long as the water end.

A RECENT INSTALLATION

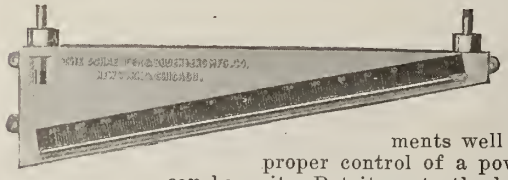
Twenty-four American Pumps including six compounds were recently installed in the new McAlpin Hotel in New York City, the largest hotel in the world. American Pumps were chosen after careful investigation in competition with numerous other makes.

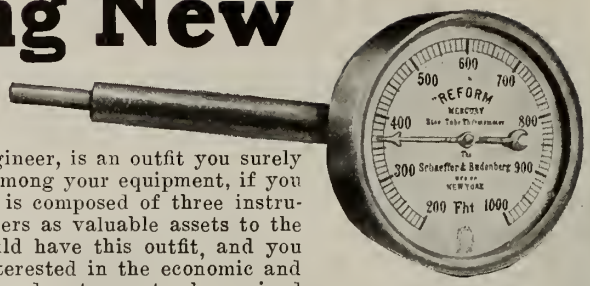
ASK FOR CATALOG.

AMERICAN STEAM PUMP COMPANY

Battle Creek, Mich.

Here's Something New





Here, Mr. Engineer, is an outfit you surely ought to place among your equipment, if you are progressive. It is composed of three instruments well known to all Engineers as valuable assets to the proper control of a power plant. You should have this outfit, and you can have it. Put it up to the boss. He is surely interested in the economic and efficient running of his plant, and will recognize in an instant the advantages to be gained through the purchase of the outfit. It consists of the following:

The "Reform" Flue Gas Thermometer

A new type of dial face, indicating thermometer. Its actuating spirit is Mercury, therefore its indications are always thoroughly accurate. Its principal working mechanism is made of steel, rendering it very rugged in construction. In fact, the "Reform" is considered as practically unbreakable. Admirably adapted for Flue Gases.

The S. & B. Differential Draft Gauge

A most satisfactory instrument for measuring the draft in flues of steam boilers. Filled with an oil called "Mineral Seal" whose capillary attraction is much less than water, hence more accurate indications. It is made of light aluminum, finely finished, is portable and readily adjusted to position.

The S. & B. Pocket Tachometer

Our new pocket Tachometer for ascertaining speeds of rotating shafts, etc. Most compact and durable instrument on the market. Thoroughly accurate in indications. Fits into the palm of the hand and is furnished in snugly fitting leather case which in turn fits comfortably in the pocket.

Do not waste any time—write *now* for special price and full particulars.

The Schaeffer & Budenberg Mfg. Co.

Chicago **Brooklyn, N. Y.** Pittsburgh

THE
CANADIAN CASUALTY
AND
BOILER INSURANCE COMPANY

ATTENTION:

In what condition have you left your heating boiler? we would like the privilege to inspect it, and report to you what has to be done before the next heating season.

CONTINENTAL LIFE BUILDING
TORONTO

J. O. B. Latour, Chief Engineer.
John J. Durance, Manager.

Phone Main 6941

YOU WANT TO IMPROVE YOUR POSITION

THEN READ THE

LIFE OF JAMES WATT

INVENTOR OF THE STEAM ENGINE

By ANDREW CARNEGIE

An entertaining book for those interested in mechanics and power, dealing with the scientific and mechanical inventions of Watt's life and times and his relations with other noted scientists and inventors.

The author, as a practical engineer, possesses all the technical knowledge necessary to give actuality to his writing, and his book is alive with enthusiasm and appreciation. He has missed no point in the romance of Watt's career, with its many thrilling episodes and its study of human nature revealed in a realistic manner. Mr. Carnegie may not point out how to become a millionaire, but he certainly sets forth considerations which may help to influence many a working man to improve his position.

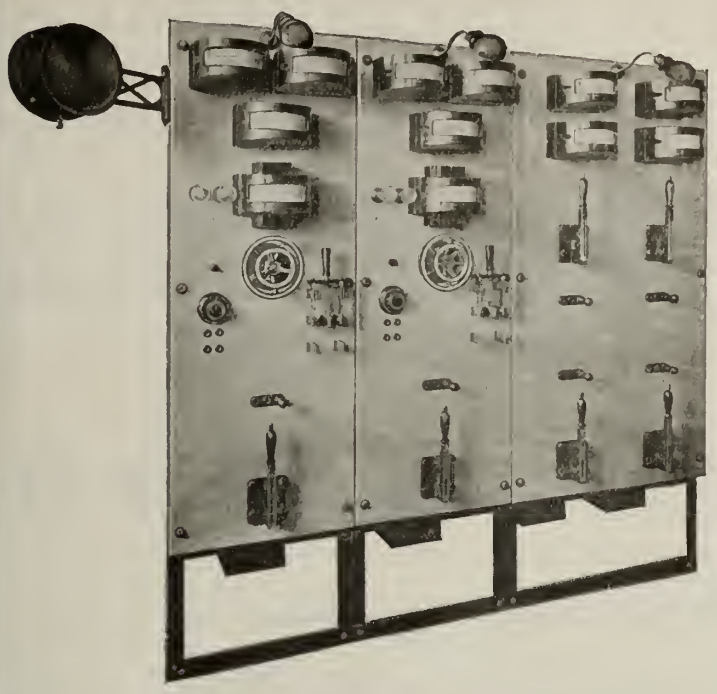
Cloth Bound. 164 Pages. Postpaid, $1.00.

OR FREE to subscribers who send in two new subsoriptions to Power House.

TECHNICAL BOOK DEPARTMENT

MacLean Publishing Co. - 143-149 University Ave., Toronto

The advertiser would like to know where you saw his advertisement—tell him.



NORTHERN ELECTRIC SWITCHBOARDS

Only the highest grade Material and Workmanship enter into the design and construction of Northern Electric Switchboards.

Our facilities for making prompt shipments are of the best.

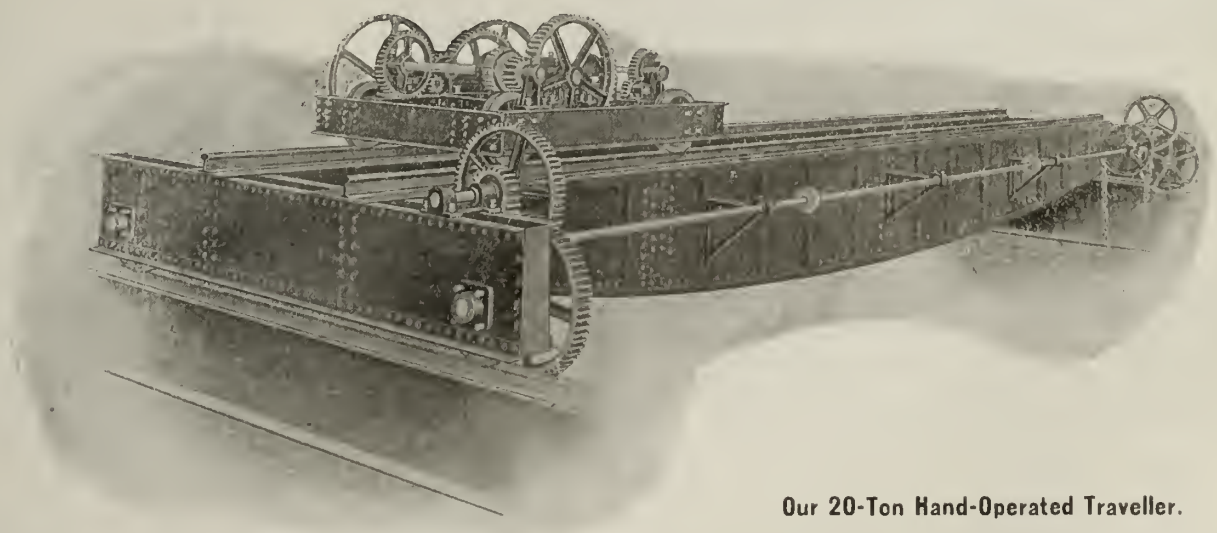
Send us your specifications and get our attractive quotation.

THE Northern Electric AND MANUFACTURING CO. LIMITED

Manufacturer and Distributor of Telephone Apparatus, Electrical Supplies, and Fire Alarm Apparatus for every possible need.

Montreal Toronto, Winnipeg. Regina, Edmonton, Calgary, Vancouver.

ALL TYPES **CRANES** ALL SIZES



Our 20-Ton Hand-Operated Traveller.

We design and manufacture all kinds of lifting and hauling appliances. Our experience and advice will be found worth having; let us know the nature of your business and we shall be pleased to advise the best equipment for your purpose.

International Marine Signal Co., Limited, Ottawa, Ont.

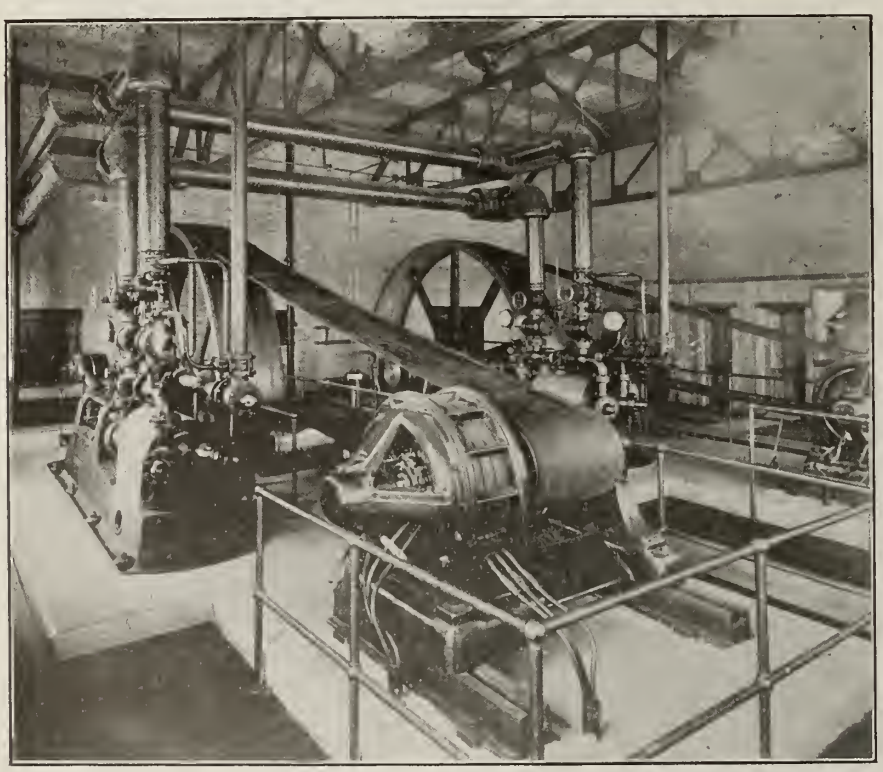
The advertiser would like to know where you saw his advertisement—tell him.

"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton " Linde " Belt Driven, Double Acting, Horizontal Ammonia Compressors Manufactured and Installed by us in Canada.

Recent Orders:—

WM. DAVIES PACKING CO.
Winnipeg, Man.
OTTAWA UNIVERSITY,
Ottawo.
HOTEL CHATEAU LAURIER,
Ottawa, Ont.
DOMINION EXPRESS BLDG.,
Montreal, Que.
MONTREAL GENERAL HOSPITAL,
Montreal.
DOMINION DAIRY & PRODUCE CO.
Regina, Sask.
DALE ESTATE,
Brampton, Ont.
DUMART BROS.,
Berlin, Ont.
CANADA CEMENT,
Venezula, So. A.
CARLYLE DAIRY CO.,
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COSGRAVE BREWING CO., Ltd.,
Toronto, Ont.
HOLT, RENFREW CO.,
Toronto, Ont.
UNITED FRUIT CO.,
Costa Rica.

AND MANY OTHERS.

The Linde Canadian Refrigeration Co., Limited

37 ST. PETER STREET, MONTREAL.

BRANCH OFFICES—Toronto, Imperial Building, Adelaide St.; Winnipeg, 909½ Main Street; Vancouver, Imperial Block, Seymour and Pender Streets; Edmonton, 562 Second Street.

THE LINDE BRITISH REFRIGERATION CO., LIMITED

ESTABLISHED 26 YEARS.

HEAD OFFICE, 35 Queen Victoria St., London, E.C.

DIRECTORS :

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CALCUTTA
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OVER 8000 MACHINES SOLD

for every purpose requiring

MECHANICAL REFRIGERATION

628-9 CORISTINE BUILDING, MONTREAL, P. Q.

A GREAT SAVER

OUR

Automatic Electric Condensation Pump

Will pump condensation water from radiation below boiler level back into boiler.

SAVES 20 to 50% COAL

IMPORTANT ! See our Exhibit in the Machinery Hall at the Toronto Exhibition.

WRITE FOR CATALOGS.

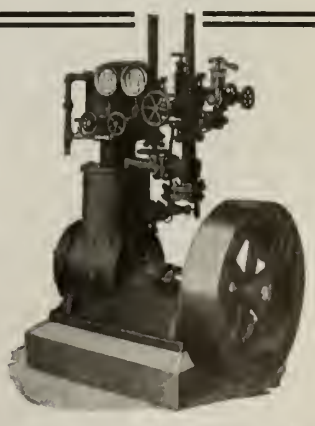
CHICAGO PUMP CO., 904-910 W. Lake St. CHICAGO, ILL.

ESTABLISHED 1867

THE VILTER MANUFACTURING CO.

242 BECHER ST., MILWAUKEE, WIS., U.S.A.

A small machine for small Ice-making and Refrigerating Plants, as well constructed and as successful in operation as larger outfits. VERTICAL SINGLE ACTING AMMONIA COMPRESSORS, different sizes. Built with fewest possible number of parts. Sold at low price. Excels all others of like size in every point—simplicity, efficiency, reliability, smoothness of action, etc. We build horizontal and vertical ICE-MAKING AND REFRIGERATING MACHINERY, a full line of CORLISS ENGINES, and MACHINERY FOR BREWERS AND BOTTLERS. Our plant covers more than eight acres of ground.



Vertical Single-Acting Ammonia Compressor, Enclosed Type for Belt-drive.

The advertiser would like to know where you saw his advertisement—tell him.

J. V. Jamison, President. T. B. South, Vice-President. J. V. Jamison, Jr., Treasurer.

This "Ad" is addressed to users of

Refrigerator Doors, Windows and Ice Chutes

in Canada

for Cold Storage, Meat, Fish, Dairy, Poultry, Fruit and Vegetable products.

We guarantee our Doors not to sag or stick in the frames.

Our Hardware weighs 60 lbs. to set.

We manufacture or sell nothing else.

Our entire time and forces are directed to this line.

We supply

Linde British Refrigeration Co.
Linde Canadian Refrigeration Co. of Canada.
Armour & Co., Chicago, Ill., U.S.
Swift & Co., Chicago, Ill., U.S.

with all they use. Our latest orders are to Swift & Co., for Toronto, Can., 30 Doors; Canadian Fish and Cold Storage Co., Prince Rupert, B.C., 110 Doors.

Send for Catalogue

Jones Cold Store Door Co.

HAGERSTOWN, MARYLAND, U.S.A.

Do You Know Your Engine Speed?

Are you getting best results from your engine, or motors, or from any of the machinery for which you are responsible? Or, on the other hand, are you overspeeding some of these machines, and wearing them out too soon, without knowing it?

The accurate, simple way is to use a

Starrett Speed Indicator

It will indicate highest speed without heating. You can use it on engines, motors, shafting, grinders, or any kind of machinery, and you'll know you're right if you go by what it says. If the light is poor you don't need to watch the dial, for the knob on the revolving disc passes under the thumb at every hundred revolutions.

Rubber tips for pointed or centered shafts prevent slipping. Costs only a dollar. Your hardware dealer will be glad to show you one.

Send for catalogue No. 19CD.

THE L. S. STARRETT CO.

ATHOL, MASS. 42-12

What are You Paying for Babbitt?

We make a complete line of Babbitts—can match any grade in the market, and at prices that will save you money—prices named f.o.b. your station.

Dominion Babbitt Metals are made by specialists who have wide knowledge of bearings and bearing troubles. They can advise you just what metal is best for the bearings of your machines, and can give you valuable information on bearings in general.

A little twelve page booklet full of just the practical information you want is yours for the asking. Write for booklet and prices in any quality of babbitt metal.

THE DOMINION METAL COMPANY

N. B. Prichard, Engineer and Manager

SHERBROOKE, P. Q.

36 YEARS
AND GOING STRONG

Magnolia Metal commonly runs ten and fifteen years and sometimes twenty years, but here is a record that tops them all. Estimating nine hours as an average working day, the time that the Magnolia bearings have run in the Ice Machine mentioned below is equivalent to thirty-six years' service, and they are still running in good condition.

THE BRYN MAWR REAL ESTATE CO.,
ENGINEER DEPARTMENT.
Bryn Mawr, Pa., May 13th, 1912.

Gentlemen:—

In answer to yours of May 8th, I wish to say that I have been using Magnolia Metal for about twenty years.

I have an Ice Machine on which the main bearings and crank pins were filled with Magnolia Metal **sixteen years** ago.

The main bearings are still in first-class shape, but two years ago our Engineer tried to run without oil on the main crank, and we had to rebabbitt it.

This machine **runs continuously for five months** during Summer, and averages **eighteen hours a day the rest of the year.** The principal use I have made of Magnolia Metal is for bearings on Ice Machines, High Speed Engines, Air Compressors, and bearings on some Pumps, and I find that it gives satisfaction wherever used.

Yours truly,
WM. SCHOCH.

SPECIAL OFFER.

PRACTICAL ENGINEER POCKET BOOK: 700 pages, over 2000 subjects. Price 40c. post paid. We import these books, in large numbers, from England, as an advertising medium and give Engineers the benefit of low price. They are highly spoken of.
Address Montreal Office.

Sold by leading dealers everywhere or by

Magnolia Metal Co.

Office and Factory:
225 St. Ambroise Street, Montreal

The advertiser would like to know where you saw his advertisement—tell him.

IMPERIAL ENGINES

THERE ARE **FIVE** CLASSES

GAS
OIL
and
SPIRIT

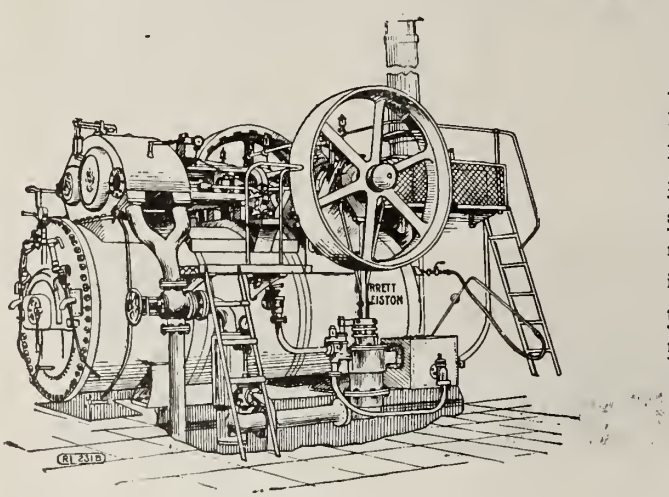
VERTICAL
and
HORIZONTAL

One Quality Only - - - **THE BEST**

Invented and Manufactured by the
KEIGHLEY GAS & OIL ENGINE CO.
Limited
IMPERIAL WORKS
KEIGHLEY, - - ENGLAND.

Sole Selling Agents in CANADA
H. W. PETRIE, Ltd.
Machinery Experts
TORONTO - - ONTARIO.

1.19 lbs. of COAL per B.H.P. Hr.



A Garrett Patent Superheated Semi-Stationary Engine has no pipe lines nor cylinder condensation losses. Note the remarkable results of this independent seven-hour test made on a stock machine.

Superheat	536.5 ° F.
I. H. P.	58.25
B.H.P.	55.6
Mech. Eff.	95.5%
Water evap. per lb. of coal	8.91 lbs.
Coal (per B.H.P. Hr.)	1.19 "
Water " "	10.66

Cut this Coupon out ***NOW.*** It will bring our most interesting booklet on the most efficient engine made. Used for every purpose.

Send me circulars re your Semi-Stationary Engine.
NAME.....
STREET.....
CITY.....

CANADIAN P. J. MITCHELL COMPANY, Limited
ENGINEERS and CONTRACTORS, 30 St. Francois Xavier Street, MONTREAL, P.Q.

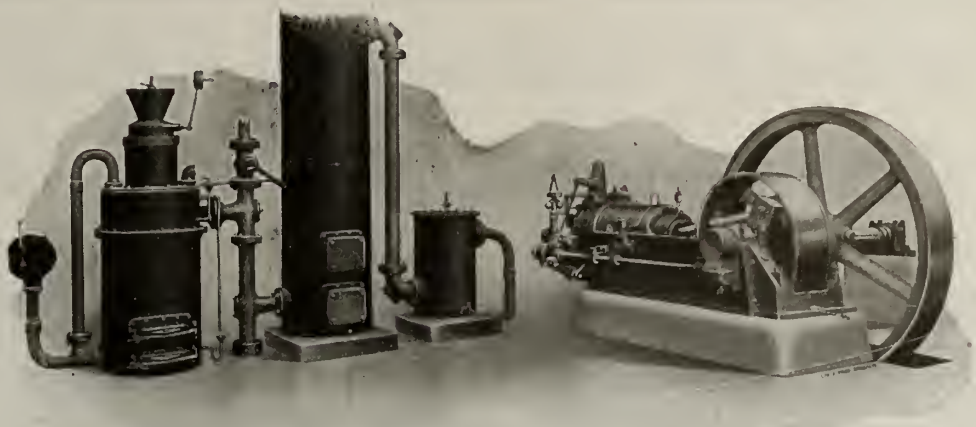
The advertiser would like to know where you saw his advertisement—tell him.

ESTABLISHED 1870.

JOHN ROBSON, (Shipley), Ltd.

SHIPLEY, Yorks, England.

Sole Makers of the **"Robson"** Oil Engine for working on Crude and Petroleum Oils.



Sole Makers of the **"Robson"** Engine for working on Towns and Suction Gas.

Photograph of Gas Engine and Suction Gas Producer Plant.

Suction Gas Producer Plants for working on Anthracite Coal, Coke or Charcoal.

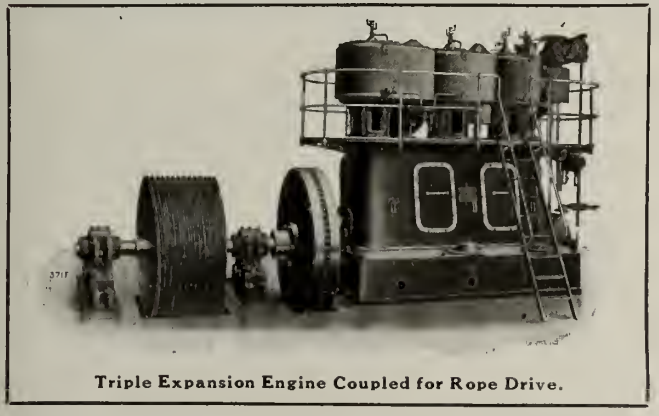
AGENTS WANTED. **WRITE FOR CATALOGUE.**

STEAM ENGINES

OF THE

BELLISS & MORCOM Vertical High Speed Type

Embody perfection of design and workmanship as evinced by their



Triple Expansion Engine Coupled for Rope Drive.

Simplicity
Durability
Quiet Running
Efficiency
Steady Running and Governing
Absence of Vibration, etc.

MANUFACTURED BY

Messrs. BELLISS & MORCOM, BIRMINGHAM, ENG.

AGENTS:

LAURIE & LAMB

BOARD OF TRADE BLDG. *ENGINEERS* MONTREAL.

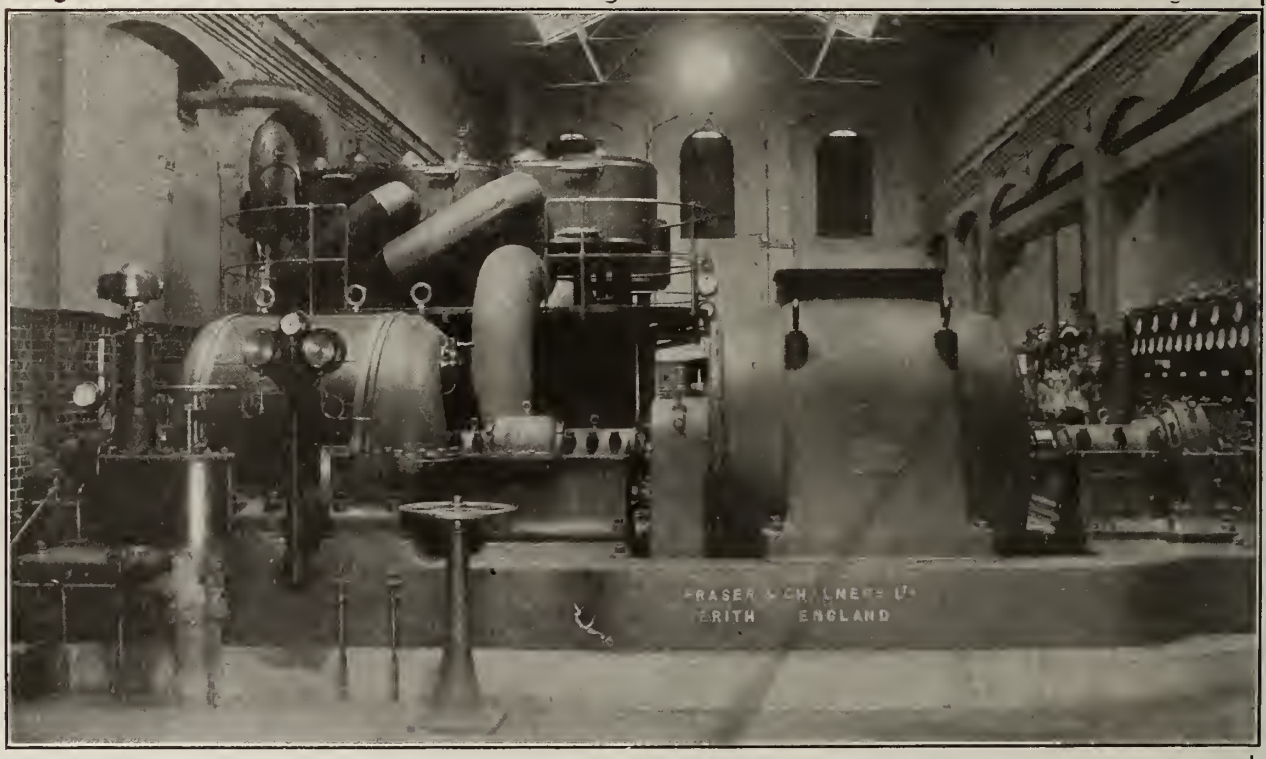
The advertiser would like to know where you saw his advertisement—tell him.

STEAM TURBINES

High Pressure Low Pressure Mixed Pressure

AND

Turbo-Blowers for Blast Furnaces or Converters



This 1000 k.w. Turbine, installed in an electric railway power station, replaced three compound condensing high speed engines and reduced the average water rate per kilowatt hour from 32 to 18 pounds of steam. Load varies from 25% of full load to 60% overload.

Fraser & Chalmers

LIMITED

Canadian Office

4 Phillips Place - Montreal, P.Q.

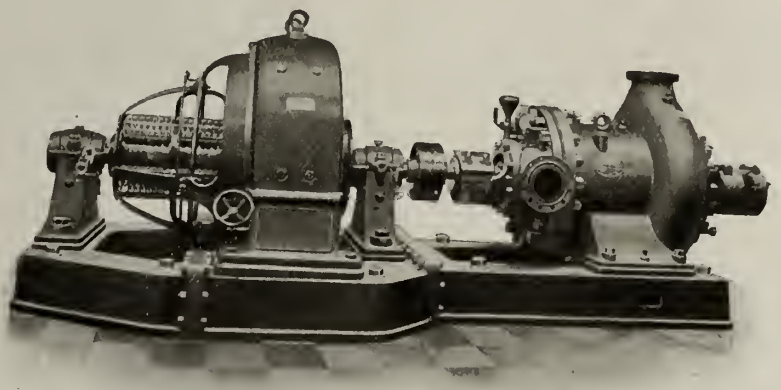
W. H. ALLEN, SON & COMPANY

LIMITED

QUEEN'S ENGINEERING WORKS BEDFORD, England

"CONQUEROR" Pumping Machinery

Suitable for low heads and up to 1,800 feet.
Constant power, constant speed, with
varying head and quantity.



'Conqueror" High-Lift Turbine Pump, driven by Continuous-Current Motor. 525 Gallons per Minute. 1,450 ft. head.

SOLE REPRESENTATIVES FOR CANADA:

CHAPMAN & WALKER, LTD.

69 Victoria Street, TORONTO
Main 7404

Engineer for Canada: A. LEO MIEVILLE, A.M. Can. Soc. C.E., A.M.I. Mech. E.

The advertiser would like to know where you saw his advertisement—tell him.

HEAVY DUTY GOLDIE CORLISS STEAM ENGINES

Nothing but the best quality of material is used in the construction of these Engines, this coupled with the fact that the most skilled Mechanics obtainable are employed, explains why they are to be found in the most modern and best equipped Power Plants in Canada.

Illustration shows the magnificent new Power House of the Grand Trunk Pacific Shops at Transcona, Man., in which we have recently installed five Heavy Duty Goldie Corliss Steam Engines and two Ideal High Speed Steam Engines.

ASK FOR A COPY OF OUR NEW CORLISS CATALOGUE.

The Goldie & McCulloch Co., Limited

GALT, - - ONTARIO, - - CANADA.

WESTERN BRANCH
248 McDermott Ave., Winnipeg, Man.

MARITIME PROVINCES
13-15 Dock St., St. John, N.B.

QUEBEC AGENTS
Ross & Greig, 412 St. James St., Montreal, Que.

BRITISH COLUMBIA AGENTS
Robt. Hamilton & Co., Vancouver, B.C.

Plant of the T. Eaton Co. Departmental Store, Winnipeg

By J. H. Williams *

Probably few people realize the large amount of machinery necessary to successfully operate a modern departmental store. The elevator service alone absorbs a large amount of power, while the heating, lighting, and, above all, fire protection must be given the most careful consideration to ensure their being at all times available.

FOREMOST among Winnipeg's many fine stores is that of the T. Eaton Co., which gives employment to 3,500 hands, and is the distributing centre for an enormous territory extending to the Pacific Coast. The general lay-out is very similar to that of the parent store in Toronto, with which many of our readers will be familiar. Though not so large as the latter, the Winnipeg building is by no means small, covering, as it does, more than half a block. It extends from Donald Street on the east to Hargrave Street on the west, and from Portage Avenue on the north more than half way to Graham Avenue on the south.

In such a store, the power equipment is, of course, both extensive and interesting. Some parts of it are accommodated in the basement of the store itself, while the main generator units, with their boilers and auxiliaries, are housed in a two-storey brick building at the north-east corner of Hargrave St. and Graham Avenue. This power house is distant about 100 feet from the store and is connected thereto by a tunnel under Hargrave Street.

The Boiler House.

The boiler house contains seven water tube boilers, of a total rated capacity of 2,225 H.P., one is a Robb boiler of 375 H.P., while the remainder are Heine boilers, built by the Polson Iron Works, Toronto. Of the Heine boilers, two are rated at 425 H.P. each, and the other four at 250 HP each The boilers carry a working pressure of 140 lbs., and are piped with Crane high pressure fittings, good for 250 lbs. In addition, each boiler is equipped with a Golden-Anderson non-return valve, fitted to the delivery pipe, thus preventing the possibility of steam blowing back from any boiler under pressure to one standing empty, even if the stop valve of the latter were inadvertently left open. The boilers deliver to a 10-inch steam header on the engine room wall.

The furnaces, which are all hand fired, are fitted with Parson's system of forced draft; the average coal consumption, taking the year round, being about 25 tons a day—seven days a week. The fuel used consists of a mixture of 3 parts of anthracite screenings to 1 part of Pittsburg soft coal slack. These proportions were arrived at after a series of experiments undertaken with a view to avoiding visits from the smoke inspector, while securing as many B.T.U. as possible at a reasonable cost.

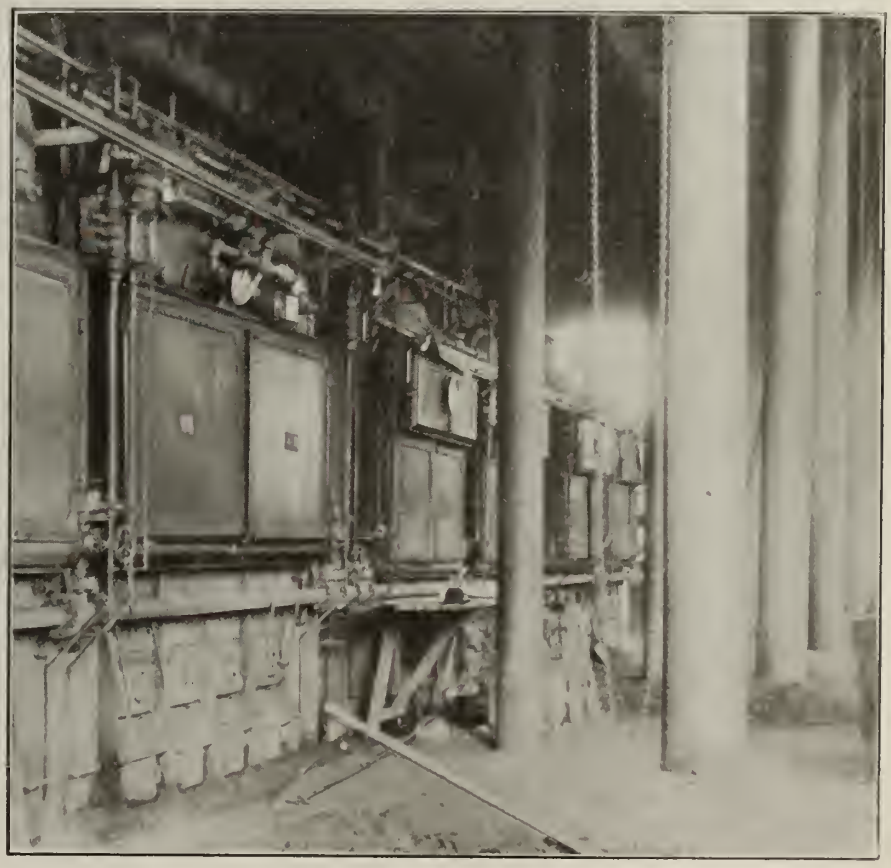
The products of combustion pass through a steel breeching to a chimney of perforated radial brick, 198 feet high from top to foundation, and 7 feet 8 inches internal diameter at top. The foundation, 36 feet square by 6 feet deep, is of concrete re-inforced with 1 inch twisted bars. The curious in such matters may be interested to know that there were 119,400 bricks used in the construction of the chimney, the weight of which is 420 tons.

The Incinerators.

For economically getting rid of the large amount of rubbish that would otherwise accumulate in so large a store, there are two incinerators, one at each end of the boiler house basement. These connect by flues with the furnaces of the two end boilers, Nos. 1 and 7. Each incinerator has an inclined chute leading up to the boiler house floor, from which it is charged. The refuse, consisting of waste paper, sweepings, broken packing cases, etc., is put upon trucks in the store, and removed to the boiler house basement by way of the tunnel below Hargrave Street. It is then raised to the boiler house floor level by a straight lift hydraulic elevator, and dumped into the incinerators through the above-mentioned chutes, the heat passing to the furnaces of the adjacent boilers.

Coal and Ash Handling.

The coal and ash handling equipment was supplied by the Jeffrey Mfg. Co., Montreal. Coal is delivered by wagon to a lane behind the power house, and is dumped through manholes into a bunker situated below ground level. From there, it is fed by worms through valves to a 14-inch belt conveyor, running at 200 feet per minute, and having a capacity of 20 tons per hour. The 3 to 1 mixture, already mentioned, is obtained by running the feed worm of the hard coal bunker three times as fast as that of the soft coal bunker. The belt conveyor discharges to a bucket conveyor, which elevates the coal to a bunker of 265 tons capacity, situated on the second floor of the boiler house. From this bunker the coal falls as required to the



INTERIOR OF BOILER HOUSE

*Associate Editor, Toronto.

boiler house floor through the vertical chutes seen in the illustration. It is then fed to the furnaces by hand.

Ashes are raked from the ashpits and removed in wheelbarrows to a hopper, which discharges them to a bucket conveyor. The latter elevates them to a bunker of 15 tons capacity on the second floor, from whence they are discharged through chutes to wagons outside the building. The ash conveyor is driven by a 7½ H.P. 220 volt, D.C. motor, and the coal conveyor by a 13 H.P. motor of the same type.

The Engine Room.

The engine room is divided from the boiler house by a fire wall. It measures 120 feet by 50 feet, and presents an extremely attractive appearance. The walls are of red pressed brick, with a 6 foot dado of white enamelled brick, while the floor is of re-inforced concrete covered with red tile. Splendid natural lighting is provided by numerous large windows, while tungsten clusters, supported by handsome brackets, supply artificial illumination. The ceiling is 25 feet from the engine room floor, and is supported by a double row of pillars; these, as may be seen, make it a difficult matter to satisfactorily photograph the engines, etc.

The engine room equipment consists of eight units, arranged on the south side of the room, as follows:—Nos. 1 and 8 are 14 in. x 14 in. Robb-Armstrong high speed horizontal engines of 150 H.P. each, running at 275 R.P.M., and direct connected to Westinghouse D.C., 110 volt compound wound generators of 100 K.W. capacity.

Nos. 2 and 3 are 16 in. and 23 in. x 10 in. Robb-Armsrong vertical compound engines of 300 H.P. each, running at 375 R.P.M. and direct connected to generators of the same make and type as Nos. 1 and 8, but of 200 K.W. capacity.

Nos. 4 and 5 engines are the same as Nos. 2 and 3, but are direct connected to Western Electric compound wound, 110 volt, D.C. generators of 200 K.W. capacity.

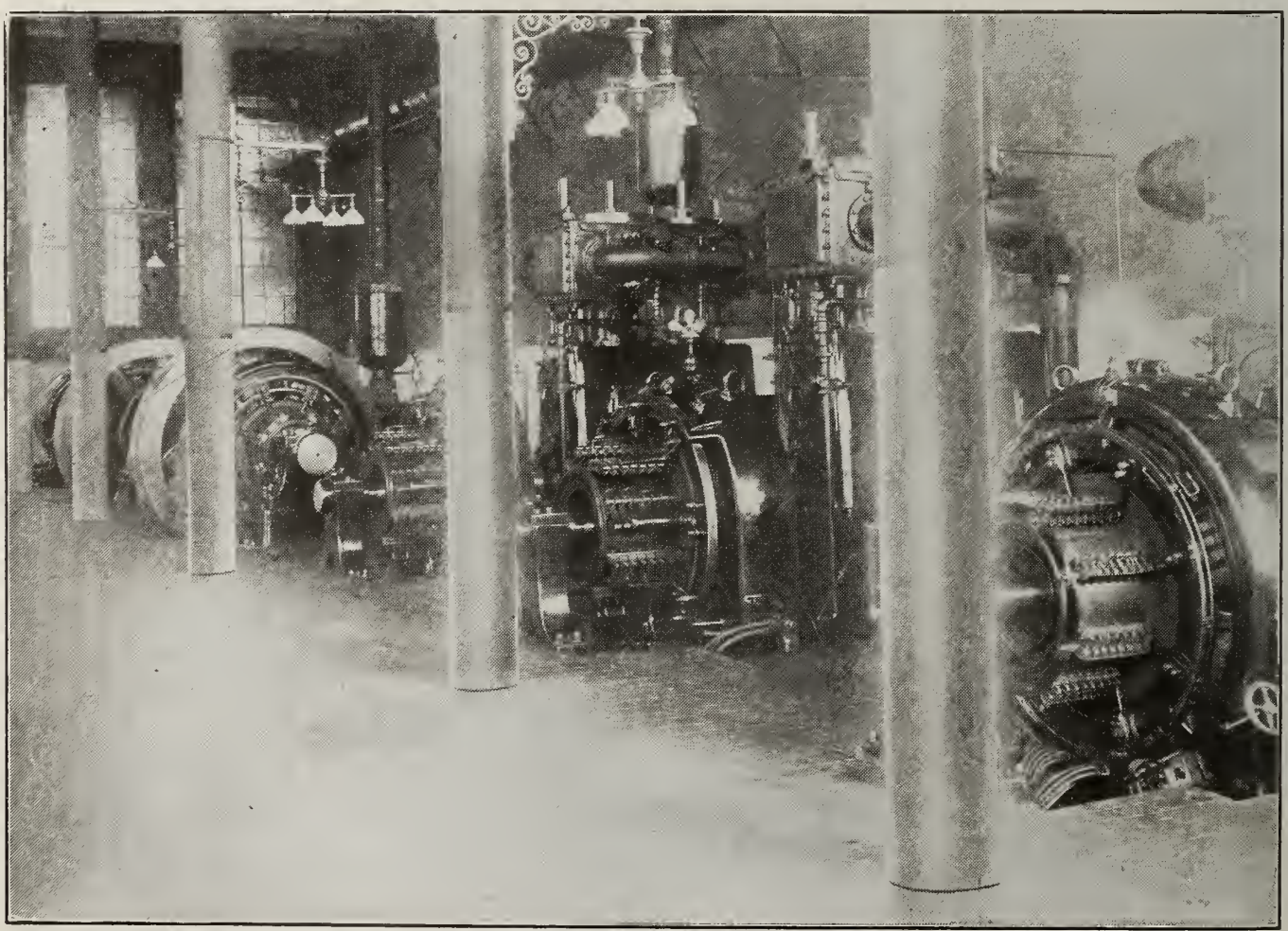
Nos. 6 and 7 are 20 in. x 20 in. Robb-Armstrong horizontal high speed engines of 300 H.P., each running at 200 r.p.m., and direct connected to Westinghouse compound wound, 110 volt, D.C. generators of 200 K.W. capacity.

With ordinary loads, four units will do the work in summer, while in winter six are required. Two machines are sufficient for the night, Sunday and holiday load. Engine lubrication is on the gravity system. All drips flow to a separator which separates the water and oil, the former going to a cesspool in the basement, while the latter overflows to a filter, from which it is pumped back to the supply tank on the second floor. All condensation from the main steam header and the engine separators is taken care of by one large trap, which discharges direct to the feed water heater. This trap was designed by members of the engineering staff and has proved highly efficient.

The engines all exhaust to a common header, the steam passing thence to a Hoppes open heater of 2,000 H.P. capacity, in which the feed is raised to about 210 degrees Fahr. The heater is cleaned out every fourth week, when about 1,000 lbs. of mud are removed, showing that Winnipeg water is not of the best from a boiler user's point of view.

Main Switchboard.

The engine room switchboard consists of ten marble panels, of which eight are generator panels and one a distributing panel for the motors driving the auxiliaries in the power house. The tenth panel is used for steam gauges ,fire alarm gong, clock, etc., and serves as a convenient place for the display of the engineering staff's certificates. The entire



INTERIOR OF ENGINE ROOM.

plant is wired on the Edison 3-wire system, with 220 volts across the outer wires. All motors are wound for 220 volts, while 110 volts is used for the lighting circuits. From the engine room switchboard a 3-wire line, consisting of ten one-million circular mil cables, is carried to the distributing switchboard located in the pump room in the store.

Auxiliaries in Basement.

In the basement below the engine room are housed the various steam driven pumps, together with storage and surge tanks and four of the accumulators for operating the twenty-three hydraulic elevators throughout the store and power plant. The boiler feed is delivered by two Worthington marine type vertical 9-6-10 in. pumps, and is automatic all through, from the boilers back to the cold water supply to heater. Thus, the pumps are controlled by governors, and the cold water supply to heater is controlled by a float; if then, all the feed valves are closed, the pump stops and the water supply to the heater is cut off. In this way all possibility of the heater being flooded is eliminated and the fireman has only the feed valve to attend to. There is a boiler compound tank on the second floor which feeds automatically and continuously into the suction line between the pumps and the heater.

Near the feed pumps are two reserve compound steam fire pumps with a capacity of 1500 gallons per minute each. These take their suction from an 18-inch main which connects the main storage tank with all steam and electrically-driven fire and elevator pumps and also with the surge tanks in the basements of the power house and store. The fire pumps, of course, are ordinarily idle; but a low pressure alarm bell on the engine room switchboard notifies the engineer when to start them up.

The main storage tank, above mentioned, is of brick and is situated below the boiler house floor. It has a capacity of 230,000 gallons, though the water is normally kept at the 160,000 gallon level. The water supply is taken from an artesian well, 329 feet deep, by means of an air lift, which delivers it into one of the steel surge tanks connected to the large brick tank. Provision is also made for using city water in emergencies. The air lift is operated by a 8x8 inch high speed Bury air compressor, driven by a 20 H.P. 220 volt motor. The supply tank can be emptied, or the water level lowered when necessary, by a 6-inch centrifugal pump discharging to the city sewer. This pump is belt driven by a 10 H.P., 220 volt motor. All drips and drainage from the power house basement are carried to a cesspool and thence pumped to sewer by a small centrifugal pump direct connected to a 2 H.P., 220 volt motor.

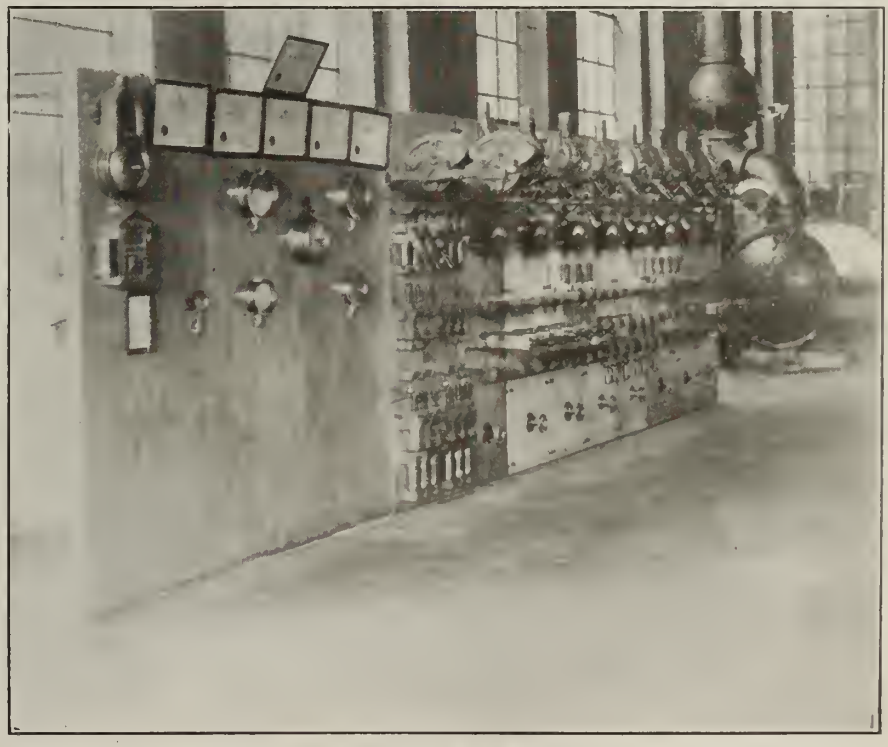
PORTAGE AVENUE, WINNIPEG—LOOKING EAST.
The T. Eaton Co.'s store is the large building on the right.

Lavatory Accommodation.

The lavatories for the power plant employes are located on the second floor of the boiler house and are of the most luxurious description, as good as may be found in the best hotels. The general finish is in grey marble and every convenience is provided, including 6 ft. porcelain bath tub, needle and shower baths. In only one plant do we remember to have seen anything at all comparable to the lavatory arrangements here.

Main Pumping Plant.

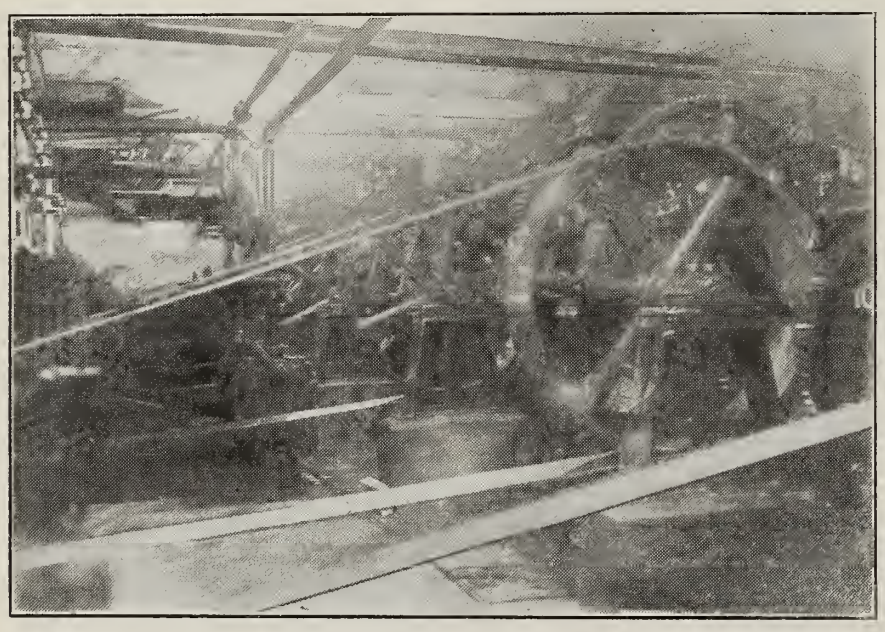
The main pumping plant is situated in the store basement and forms a very complete and efficient installation. Here are located seven Gould 10x12-in. triplex single acting power pumps, each having a capacity of 480 gallons per minute. They are belt driven from 50 H.P. compound wound motors, which are automatically controlled by Cutler-Hammer controllers. The latter may be set to start and stop the motors when any desired pressure has been reached; the limits ordinarily worked between being 110 and 130 lbs. per square inch. These pumps are used for the hydraulic elevator and fire protection service, and discharge to the pressure tanks or accumulators, of which there are twenty-two in all, each of 1000 gallons capacity. They draw from the 18-inch main, pre-



THE ENGINE ROOM SWITCHBOARD.

viously mentioned as serving the fire pumps in the power house basement.

There are also two smaller Gould pumps of the same style, having capacity of 180 gallons per minute each and driven by 20 H.P., compound wound motors. They are also operated by Cutler-Hammer automatic controllers. These smaller pumps provide the ordinary water service throughout the store, but are cross-connected in such a way that they may be used for elevator and fire protection service if necessary. They take water from an open tank and deliver it through an accumulator to the service pipes at 100 lbs. pressure. The open tank from which they draw is supplied from an artesian well 329 feet deep, the water being raised by an air lift as in the case of the well previously mentioned. Air for this second lift is furnished by an 8x8 in. motor driven Rand compressor, while two 6x6 in. Bury compressors deliver air into



INTERIOR OF PUMP ROOM.

the elevator accumulators, and also operate the device for opening and closing the gates of the passenger elevators. Nearby are two motor-driven vacuum pumps which take care of the returns from the Webster heating system, delivering them to the heater. In addition, there is a similar pump in the engine room basement and another in the store basement—making four in all.

In the pump room is also located the main distributing switchboard mentioned on page 215. This consists of four slate panels and measures 7 ft. 6 in. high by 8 ft. long. From this board, two 3-wire circuits run to each floor of the store, lighting and power feeders being taken off the same circuits. At either end of the pump there is a header supplying the risers and stand pipes of the sprinkler system, these headers being connected with the elevator service accumulators.

Cash Handling System.

All cash is conveyed by the pneumatic tube system, air being furnished at 13 oz. pressure by three No. 7 Green rotary blowers (Roots type) situated in the pump room. Each blower has a capacity of 8000 cubic feet of air per minute, one being now found sufficient for the work. This economy has been effected by equipping 80 out of the 105 separate lines with automatic cut-offs, which shut off the air from a line in which there is no cartridge. The total length of piping in the cash system is seven miles. It would be interesting to know the total mileage traveled daily by the 3,000 cartridges in use.

Hot Water Supply.

For this supply, water is taken from the store service cold water line and passed under pressure through a tubular heater in the engine room basement. Heat is taken from the main exhaust line, the water passing direct from the heater to the hot water mains throughout the store, etc., at a temperature of 135-150 F.

Heating, Lighting and Ventilation.

This store is heated on the Webster system, the radiators taking low pressure steam at about 2 lbs. per sq. inch from the exhaust line. The vacuum pumps maintain a vacuum of from 5 to 10 inches of mercury and discharge directly to the boiler feed water heater in the engine room.

The store basement is lighted by individual drop lights and by Benjamin clusters made up of 40 and 60-watt tungsten lamps. The ground, second, third, fourth and fifth floors are illuminated by 2000 C.P. Jandus enclosed arc lamps, while the remaining floors are lighted by Benjamin clusters similar to those in the basement.

The ventilation system is about to be re-designed and a complete new installation will probably be put in the near future. At present, ventilation is taken care of by exhaust fans located in various parts of the store.

Mechanical Staff.

The power house staff consists of 13 men, seven in the boiler house and 6 in the engine room. The men work in 8 hour shifts; so that two men are on duty in the engine room at all times. Mr. R. Hutt is chief engineer for the whole store and has Mr. C. Lane as his chief assistant.

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PRIVY COUNCIL JUDGMENTS.

ONTARIO will be cosiderably richer, and the Canadian Niagara Power Co. to the same extent poorer by virtue of a judgment handed down by the Privy Council recently. That honorable body has decided that the construction placed upon the contract between the province and the company by the Attorney-General of Ontario, is the correct one, thus reversing two judgments given in Ontario courts in favor of the power company. The result will be the payment into the Provincial Treasury of many thousands of dollars being the amount of money due for the right to utilize the power-producing waters of the Niagara River, over and above the amount heretofore annually paid by the company. The amount of the unpaid debt reaches large proportions, because the contract, in force for ten years, has been paid for according to the company's interpretation of it.

The Judicial Committee of the Privy Council on July 24, reversed the judgment of the Court of Appeal of Ontario, delivered on February 1st, this year, in the case of the Toronto and Niagara Power Co. The Privy Council finds that the company is entitled to erect and string power wires along the streets of North Toronto for the distribution of electric power without the consent of the town corporation. The company recently decided to devote $3,000,000 to extensions of its system, whereby, besides the three 8,500 kilowatt units being erected in the power station at Niagara Falls, four others are to be installed, bringing up the total capacity for generation of electricity to 125,000 horsepower. The proposition in regard to which the company and the corporation came into conflict was that of a transmission line from Niagara to Toronto for a voltage of 85,000.

Trade Journal Publicity--Its Meaning to Gas Engine Makers*

By E. R. Shaw **

The place and power of the trade journal is here clearly demonstrated, and while the occasion on which the address was delivered particularized the field somewhat, it will be quite evident on reading over the paper that the contents are applicable to manufacturers and industries generally.

WHEN I was honored with a place on the programme of this Convention and assigned my subject, I was afraid that from such a long title you would suspect a long talk. I am not going to emulate a darky preacher who had the reputation of talking so long that nobody could keep awake, and who talked so loud that nobody could go to sleep.

Potency of the Trade Paper.

The most potent factor in our industrial and commercial development during the past generation has been the Trade Paper. It has rapidly increased in importance in every field of endeavor. No other class of publications are read as thoroughly and earnestly as Trade Papers. We can all agree to the proposition that there is an inexorable principle in nature that is constantly seeking to establish an equilibrium, or in other words, to adjust things in such a way that friction will be reduced and waste effort abolished. The Trade Paper may be defined as a finely adjusted implement of twentieth century progress that automatically selects and attracts only the interested, and eliminates all others. Like other economic conveniences, specialized publications are unappreciated and discredited by some, but to the constituency which it seeks to aid, it goes modestly and noiselessly and greets its readers with a radiance of intelligence because it is one of the hand-maids of education. As a people we are looking for the best systems, for the most economical methods, and our progress as a nation is because of the fact that we have less conservatism, less routine in our way of doing things than have other nations.

In the material world there are no accidents recognized, and if we mill but trace to their antecedent cause those things which we call results, we will find a well-defined reason for everything. Success is won by application of substantial reason—not chance. The Trade Paper is the embodiment of all that is substantial, the foundation of that which is safe and secure. Its pages reflect that which has been tried and found true. Its influence can not be overcome nor its power adequately estimated, for its force is always along the lines of least resistance.

Trade Paper a Sale Producer.

There are about as many methods of developing sales as there are methods of developing power, and from the conditions it can be determined which method fulfills the requirements most accurately. The specialized Trade Journal is a thing of life and vitality which conforms to the economic laws of marketing in the special field it serves. It is an automatic selector of possible buyers and a developer of latent want into commercial demand. If rightly hitched to the load it is the modern engine for marketing those products whose customers can be segregated from the general public. The Trade Papers are the most effective and economical customer finders and sales makers in any field, because they are the publications which appeal to that field and to no other. Such publications, and only such, offer a practically wasteless way to place your product before those whose interest finds expression in orders.

Trade Paper Advertising.

Of the millions of people in this country only a few thousand perhaps have any possible use for gas engines and their auxiliaries, and you can not afford to advertise through general mediums to the millions who have no interest in your product in order to reach the few thousands who are your possible customers. A salesman's time is too valuable to use for any of the work that can be done by advertising. So says a man who makes a business of training salesmen. The man who says "There is nothing like a good salesman to move your goods," thinks he has dealt advertising a body blow with that half-truth, but the man who has really thought about it and the man who has tried the combination says, "There is nothing like a good salesman and good advertising." That's the whole truth.

What may be called the machine work of selling, getting attention to the product, telling what it is and what it will do, and thus awaken interest and create desire—this is work for the printing press, because the printing press can do it in a wholesale or quantity way much cheaper than it can be done by salesmen. This work thoroughly done leaves the salesman only his proper function to perform, leaves to him the skilled hand and head work of showing the buyer just how the product fits his individual and perhaps unusual requirements, quoting prices, terms and closing the order.

An Aid to Salesmanship.

How often have you invited a salesman in and given him a chance just because you had heard of his goods—had noticed, perhaps without consciously reading, the advertising of his house, and had been favorably impressed? Advertising does get attention and creates interest and desire now as never before, and the salesman who once regarded it with contempt or as a rival—as something that was after his job and would get it if he didn't watch out, now looks upon it as his most efficient assistant, as one of the tools of his business. He is the first to fight for it if it is in danger of being cut off or reduced. He even makes suggestions for its improvement, just through an enlightened self-interest, and the same motive moves him to see that advertising gets the credit for the work it has done in his territory—work which only he has had the opportunity to see.

Suggested Line of Action.

Give your salesmen the help they are entitled to. Save their time, which is your money, by making your goods known—favorably known through advertising in the papers that are read by the people who use your goods. Use enough space to tell your story well and in an interesting way. Use enough space to impress the unknown prospect, who has no other way of judging you, that "here's something worth while; the man who makes it must believe in it, or he would not spend money advertising it."

Do that and you are well on your way toward the favorable acceptance of your product. How much is enough space? That depends on the product—how it is marketed, competition, distribution, a dozen things, perhaps, on which it is easy to get safe advice. If a full page is your size, a half-page might be extravagant. Maybe a quarter-page is enough, but decide to do it right, and do it right soon.

*Read before the National Gas Engine Association, Milwaukee, Wis., June 20, 1912.
**President Federation of Trade Press Associations in the United States.

Canadian Association of Stationary Engineers Convention

Belleville, Ont., Where the Recent Convention of the Canadian Association of Stationary Engineers Was Held, Has Reason to Feel Proud of Itself for the Ample Provision Made, and for the Success Which Attended the Efforts of Those of Its Citizens Who Were Charged With Carrying Out the Arrangements Which Secured Such Handsome and Hospitable Treatment for the Various Delegates, Exhibitors and Friends Who Were Present.

THE 23rd Annual Convention of the Canadian Association of Stationary Engineers was held in the town hall, Belleville, Ont., from July 23rd until July 25th, inclusive. Reference is made on our editorial page to a brief discussion of some general phrases of the proceedings as they impressed us. It will, therefore, only be necessary for us to outline and record here, as concisely as possible, the various functions.

Convention Opening.

The convention was opened on Tuesday, July 23rd, at 11 a.m., by his worship, Mayor Vermilyea, of Belleville, who in the course of his address extended a hearty welcome to all connected with the association and its auxiliaries. Messrs. Norris, Wickens and Crockett replied on behalf of the C.A.S.E. executive, after which, adjournment was made for lunch.

On again assembling at 1.30 p.m., a visit was paid to the rolling mills plant, those participating being shown through and having the various features and processes explained by Mr. Thomas Moore, local manager of the works.

Engineers in Session.

At the close of the visit to the rolling mills, and on return to the City Hall, the engineers held their first session, Mr. William Norris, executive President being in the chair. The reports of the secretary and treasurer were read, and showed the association to be in a stronger position financially than ever before, making possible a more aggressive campaign being inaugurated and carried on for the propagation, particularly of the educational and legislative sections of the society's work.

Ladies Auxiliary.

During the afternoon a ladies auxiliary was organized in connection with the association, and after preparing a constitution, the following officers were appointed:—

Past Pres.—Mrs. A. M. Wickens, Toronto.

Pres.—Mrs. W. A. Crockett, Hamilton.

Vice-Pres.—Mrs. F. H. Chesher, Belleville.

Secretary.—Mrs. A. Kastella, Stratford.

Treasurer.—Mrs. C. J. Peppin, Belleville.

Conductor.—Mrs. S. E. Cosford, London.

Doorkeeper.—Mrs. William Cooke, Belleville.

Evening Cruise on Bay of Quinte.

A fitting finale to the opening day's proceedings was a cruise on the Bay of Quinte in the evening. Delegates and invited guests to the number of 300 availed themselves of the invitation of the local C.A.S.E. Lodge, and it is no exaggeration to say that the trip was heartily enjoyed and favorably commented on by all present. The good ship America, of Kingston went as far as Deseronto, the out and return occupying rather over 3 hours. Dinner was served during the evening, after which, addresses by prominent local citizens and engineers, music by local and outside talent, dancing, etc., contributed to the most fastidious.

THE 23RD ANNUAL CONVENTION OF THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS, BELLEVILLE, ONT., JULY 23, 24, 25, 1912. GROUP OF DELEGATES, EXHIBITORS AND GUESTS.

Engineer Delegates.

The following engineer representatives —executive and local, took part in the various sessions of the C.A.S.E.:—

W. A. Crockett, Mount Hamilton; W. E. Archer, Toronto; H. E. Clarke, Hamilton; R. Dyson, Guelph; J. A. Robertson, Stratford; H. L. Bishop, Hamilton; A. M. Wickens, Toronto; S. E. Crossford London; William Norris, Chatham; A. Kastella, Stratford; G. E. Thomas, Owen Sound; M. Scringeour, Stratford; Wm. Sanderson, Chatham; J. R. Stephenson, London; W. J. Paynter, London; J. Tweedale, Toronto; J. Brown, Toronto; S. Smith, Port Arthur; Wm. Noble, St. Thomas; W. C. McGhie, Toronto.

Exhibitors Association.

The exhibitors association in an individual and collective capacity contributed their quota towards familiarizing engineer delegates, through the instrumentality of tastefully arranged and variously equipped booths, with the latest developments in power plant apparatus and specialties. They further provided an excellent programme of sports on the afternoon of Wednesday, July 24th, at Queen Victoria Park. The exhibitors and their representatives were as follows:—The James Morrison Brass Co., Toronto, per J. E. Fiddes; the Goldie & McCulloch Co., Galt, per E. F. Hetherington; the Canadian Morehead Mfg. Co., Woodstock, per G. W. Cole; the Boiler Repair & Grate Bar Co., Toronto, per W. Chown; the Lunkenheimer Co., Cincinnati, per E. A. Wilkinson; the Garlock Packing Co., Hamilton, per Messrs. Pulver & Fletcher; F. Reddaway & Co., Toronto, per Mr. Harrison; "Power" of New York, per Jack Armour; Greene, Tweed & Co., New York, per Mr. Vaudewall; the Joseph Dixon Graphite Co., per Messrs. Brooks and Chase; Jenkins Bros., Montreal, per Mr. Thomas; the Dart Union Co., Toronto, per Messrs. Goff and Archibald; the Trill Indicator Co., Corry, Pa., per W. S. Trill; the "Canadian Manufacturer," Toronto, per G. C. Keith; the Canadian Fairbanks Co., Toronto, per J. N. Charles; the Quaker City Rubber Co., Philadelphia, per Mr. Wathall; the Canadian Steam Boiler Equipment Co., Toronto, per W. J. Smith; Strong, Carlisle & Hammond, Cleveland, O., per Mr. McFarland; H. W. Johns-Manville Co., Toronto, per T. H. Barnes; the Dunlop Tire & Rubber Co., Toronto, per H. C. Austin; the Peerless Rubber Co., New York, per Messrs. Roblin and Heintzman; the S. F. Bowser Co., Toronto, per W. A. Armstrong and E. J. Murphy; the Cling Surface Co., Buffalo, per J. B. Faatz; the Dearborn Drug & Chemical Co., Chicago, per J. N. Gregory; the Asbestos and Rubber Goods Co., Toronto, per M. Stevenson; the Goodyear Tyre & Rubber Co., per A. Whitting; "The Power House," Toronto, per H. V. Tyrrel and Peter Bain.

Souvenirs, consisting of pipes, caps, pocket knives, pencils, steel rules, fobs, rubber heels, delegates and exhibitors badges, etc., were distributed freely amongst engineers and others by the foregoing exhibitors' representatives.

General Features—Wednesday.

The C.A.S.E. delegates were in session during the forenoon of Wednesday, while the ladies of the party at the same time enjoyed a drive round the city and outskirts. All were on hand of course, after lunch, to participate in the sports programme, and immediately previous to the commencement of the latter a group picture was taken in front of the Court House. In the evening a smoker was held in the City Hall, and entertainment was provided for the ladies at the local moving picture theatre. The programme at the former function included a boxing bout by two local exponents of the "manly art;" the presentation to W. Cooke, secy. Belleville 34 C.A.S.E., of a handsome alarm clock for his services as the local officer in charge of the exhibitors arrangements; the display of the effects of personal magnetism by Mr. Lindsay, Belleville, city engineer; a "heart to heart" talk by Jack Armour of "Power," New York, and a few songs by capable local artists.

Closing Day.

Meetings of the engineers and exhibitor's association, occupied the greater part of the morning of the closing day, and the meeting of the former, after lunch, at which the installation of officers for the coming year took place, rung down the curtain on the 1912 convention of the Canadian Association of Stationary Engineers.

A past president's jewel was presented to the retiring secretary, Mr. W. A. Crockett, and a bar was ordered to be placed on a past president's jewel for A. M. Wickens, the retiring executive treasurer.

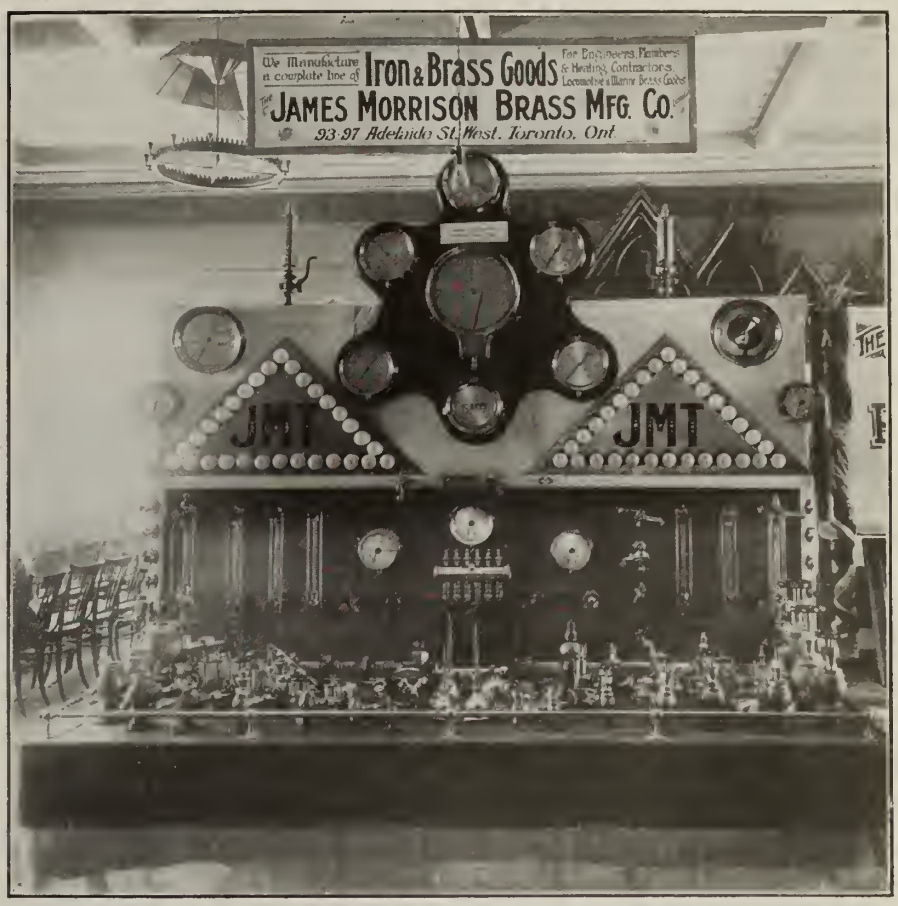
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EXHIBIT OF THE JAS. MORRISON BRASS MFG. CO., LTD., AT BELLEVILLE.

Engineers Officers, 1912-13.

Past president, W. Norris, Chatham; president, J. A. Robertson, Stratford; vice-president, S. Cosford, London; conductor, F. Chesher, Belleville; doorkeeper, H. L. Bishop, Hamilton; secretary, A. Kastella, Stratford; treasurer, W. E. Archer, Toronto.

Exhibitors Association Officers.

The exhibitors' association elected officers for the year, as follows:—President, J. E. Fiddes, of the James Morrison Brass Works, Toronto; 1st vice-president, E. A. Wilkinson, of the Lunkenheimer Co., Cincinnati; 2nd vice-president, B. W. Walthall, of the Quaker City Rubber Co., Philadelphia; trea-

surer, H. V. Tyrrell, manager of the Power House, Toronto; secretary, G. C. Keith, editor of the Canadian Manufacturer, Toronto; assistant secretary, J. N. Charles, of the Canadian Fairbanks-Morse Co., Toronto; chairman of exhibits, E. F. Hetherington, of the Goldie, McCulloch Co., Galt; chairman of entertainment committee, C. P. Archibald, of the Dart Union Co., Toronto; chairman of reception committee, C. F. Heintzman, New York. The next convention will be held at Owen Sound.

CANADIAN MOREHEAD COMPANY

THE Canadian business of the Morehead Mfg. Co., of Detroit, Mich., manufacturers of the Morehad system of steam line drainage and boiler feeding, has grown to such proportions in the past few years as to make necessary the organizing of the Canadian Morehead Mfg. Co., Ltd., with headquarters at Woodstock, Ont. The new company is incorporated under the laws of Ontario with the following officers:—

A. Fitzgerald, President; D. E. Stott, Vice-President; Geo. H. King, Sec'y.-Treas. and General Manager.

The Morehead line of non-return, return, vacuum and condenser steam traps will be manufactured under the direct supervision of Mr. Geo. W. Cole, who has represented the Morehead Mfg. Co. for the past nine years. One of the new products of the company is the condenser trap, designed for use on low pressure and exhaust steam heating lines. This device is in general appearance similar to the old and well known Morehead return steam trap. In detail, however, the condenser trap differs from the return trap in the addition of a cold water connection made through a flexible tube with the tank of the trap. The flexible connection terminates in a perforated pipe inside of and running the length of the trap tank. In short, the condenser trap is nothing more or less than a combination of the principles of the jet condenser and the Morehead automatic return steam trap.

Eliminating High Pressure.

In a recent article on "Economic Efficiency of Steam Mill Plants," James M. Taggart, M.E., says:—"One reason that leads to the use of high pressure steam in heating and drying apparatus is the fact that a positive pressure is often needed to remove the condensation. That is, to render the apparatus effective the condensation must be removed as fast as it collects. High pressure is, however, not necessary to accomplish this. It can be accomplished more easily by means of a condenser trap in which a vacuum is formed by a cold water spray. In practice vacuums ranging from 5 to 22 pounds per square inch are obtained. In some cases vacuum pumps have been used for this purpose. However, for handling hot water, traps are the most efficient and reliable."

Description of the Trap.

The condenser trap is held to dispense with the use of vacuum valves and pumps continuously used on such systems, and furthermore it may be installed at less cost. Connected to the return line of vacuum heating systems where a difference of pressure is maintained between the ends of the system, the line condensation and accumulating air is taken into the tank of the condenser trap as in the case of the return trap, but with the added pulling power of the vacuum created in the tank of the condenser trap. When the steam is turned on in the heating system, the various lines of which are full of air, the cold water supply valve is opened slightly. As the condensation from the return lines and the condensing water fills the tank the latter tilts, opening the live steam valve, thus allowing the steam pressure to enter and discharge the water contents into a return steam trap above the boiler or into an open heater.

As soon as the water is discharged, the tank, containing the steam which is left after that operation, resumes a horizontal or filling position. The tank returning to its horizontal position automatically opens the control valve on the cold water inlet and allows the cold water spray to come in contact with the live steam contained in the tank. This cold water condenses the steam and forms a vacuum in the tank of the trap, which in turn performs the usual functions of created vacuum in heating systems, of pulling the condensation from the lines to be drained.

Water Consumption Small.

The cold water supply is furnished either from city water works or a tank or other source that is available for that purpose. A very small amount of water is required in the condensing process. A receiver is always used in connection with the condenser trap, the water seal in the receiver taking the place of thermostatic valves on the heating system. The condenser trap is used as the lower trap, taking the place of the return trap in the Morehead standard double trap installation, the lower or condenser trap, discharging to the return trap placed above the boiler.

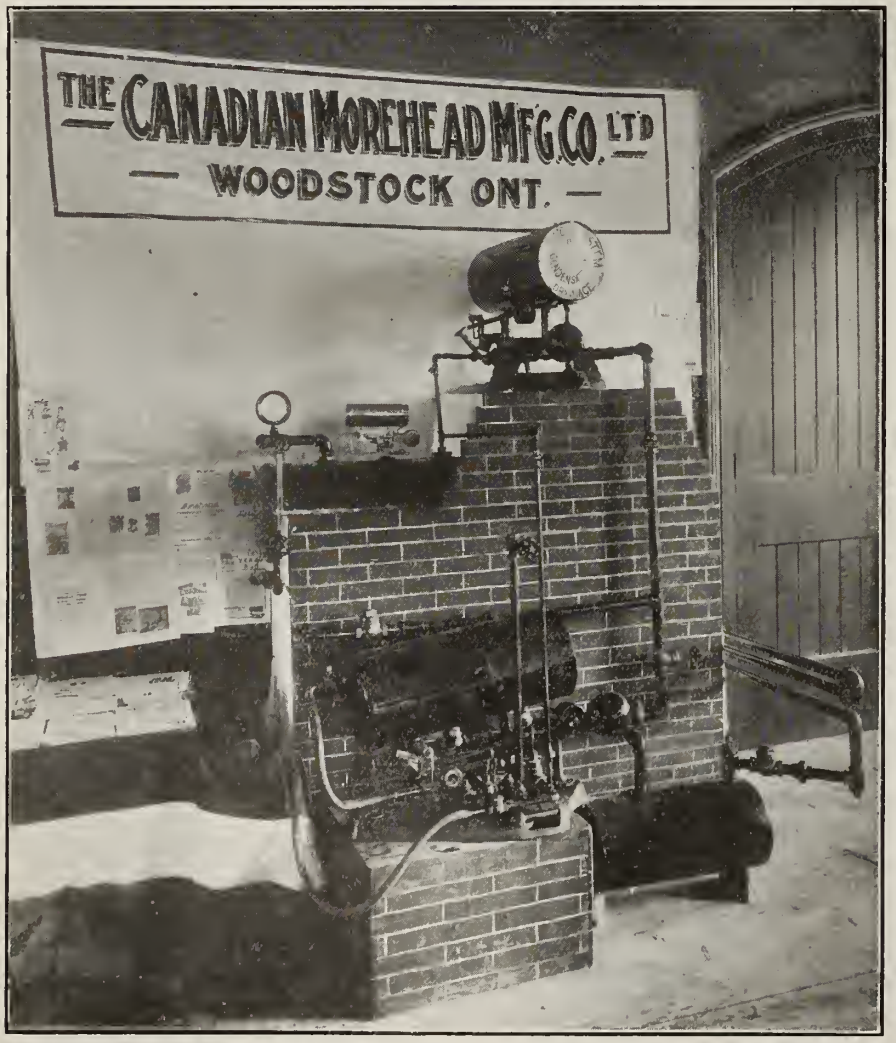

EXHIBIT OF THE CANADIAN MOREH EAD MFG. CO., LTD., AT BELLEVILLE.

LOCOMOTIVE BOILER TESTS.

TWO low-water tests were carried out recently on locomotive boilers, one equipped with a Jacobs-Shupert sectional firebox and the other having the ordinary form of radial stay construction. In the radial stay type the flat side and crown and wrapper sheets are connected by radial stay-bolts, while in the Jacobs-Shupert type the flat plates are replaced by a series of corrugated channel-form sections riveted together with the flanges turned from the fire. Stay-plates or diaphragms are used instead of stay-bolts, and the rivets connecting the sections together serve also to connect the sections to the stay-plates.

In making the tests, which were carried out by the Jacobs-Shupert U.S. Firebox Company at Coatesville, Pa., two full-size locomotive boilers designed for high-speed passenger service were used, identical in size and design except that one had a sectional firebox while the other had one of the ordinary radial stay type. Both boilers were mounted in a field 50ft. apart, and were operated from a shelter 200 ft. from the nearer boiler. Oil was used for fuel, because of the danger to which a fireman shovelling coal would have been exposed. In the process of testing, each boiler was brought to a condition of operation closely approaching a maximum power of 1,400 h.p., which is equivalent to that required to haul a heavy passenger train at a speed of 60 miles an hour. The supply of feed water was then shut off, all other conditions remaining unchanged, and the water level gradually fell and exposed the crown sheet and other portions of the heating surface to the full effect of the fire. The boiler having the sectional firebox was tested continuously under these severe conditions for 55 minutes without developing any failure, although the water level fell to a point more than 25 in. below the crown sheet. The test was then discontinued because the small supply of water which remained did not evaporate fast enough to supply the necessary draught to maintain the fire. At the conclusion of the test the firebox of this boiler was apparently in good condition and ready for further service.

The ordinary radial stay boiler was then tested under identical conditions, and after the test had been in progress for 23 minutes, and the water level had fallen to 14½ in. below the crown sheet, an explosion occurred. The crown sheet, and the stays which held it in place became highly heated and pulled away from each other, with the consequence that the pressure in the boiler was released. The discharge of steam was through the firebox, and the force was sufficient to throw parts of the furnace in all directions and to lift the entire boiler, which weighed 40 tons, several feet above its foundations. The damage was such as to necessitate the reconstruction of the boiler.

The boiler having the Jacobs-Shupert sectional firebox carried between 215 lbs. and 225 lbs. for the first 27 minutes, and the pressure gradually dropped thereafter until it reached 50 lbs., at the end of the test. The steam pressure on the radial boiler varied between 220 lbs. and 230 lbs., and it was 228 lbs. when failure occurred. The gauges and the water level in the gauge glass were read by telescopes.

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THE MORRISON WATER TUBE BOILER.

THIS new water tube boiler is of the vertical type and is built in banks or sections. One bank or section is used from 100 h.p. up to 300 h.p. A double section is used from 350 h.p. up to 650 h.p., and beyond that a triple section design is used. Each section consists of 48-inch diameter steam drum and a 34-inch diameter mud drum connected by five rows of tubes. The tubes in the centre row are perfectly straight throughout their length. The intermediate and outer rows consist of tubes the upper and lower ends of which are bent to a large radius for a length just sufficient to effect a spreading of the tubes equally distant apart across the entire width between the furnace walls. This eliminates all dead alleys, and renders it unnecessary to use baffle tiles to force the heat among the tubes. In a double or triple section the tubes are thus uniformly spaced across the boiler regardless as to which bank each tube may belong. The heating and burning gases are thus evenly distributed as the friction in all alley-ways is practically uniform. In addition combustion must take place among the widely spaced tubes, instead of choking in crowded banks and wasting in large dead alleys.

The water line is about the middle of the top drums where the surface of disengagement is large and the opportunity for mechanical entrainment of water is least. The most intense heat occurs among the forward tubes where the circulation must be upward in each section. This means a positive and easy circulation, the upward current being balanced by a downward current in the rear tubes. The circulation is, in the top drums, from front to rear, and in the bottom drums from rear to front. The circulation is thus unchoked at any point in its travel and there results a rapid circulation through the ample space afforded by the drums. The cross connecting tubes from one bank to the other offer a further means of maintaining a quiet water level, as well as serving to steady the sections. The triple pass is used because of the double advantage of the long travel, during which the gases loose their heat, and the elimination of any necessity for separate stacks from the ground up. Individual stacks may be placed directly over the third pass, or a connection placed there or in the rear may lead to the main flue or stack.

This boiler will be built for any desired pressure and details have already been worked out for pressures of 100, 125, 150, 175, and 200 pounds per square inch. For cleaning the flue sheets, etc., there is placed in each side wall, just above the bottom flue sheets, a series of small pipe-shaped openings with covers which are located opposite each wide space in the outer tube rows. These, together with the peculiar arangement of the tubes, afford means for thoroughly blowing off all soot from the flue sheets. Vertical tubes and larger doors placed higher up in the walls for blowing off the soot effect a thorough freedom from it among the tubes.

This boiler is being placed upon the market by the Sharon Boiler Works Co., Sharon, Pa., and is very similar to the Wheeler boiler manufactured by the same company, of which about 100,000 h.p. have been installed to date.

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A CONTRAST.

WHAT is the difference between an English and an American engineer? Inter alia we tender this distinction; when the English engineer goes to an institution dinner he seeks in the reception room everyone whom he knows. When the American engineer goes to an institution dinner he seeks, also in the reception room, everyone whom he does not know. We have seen evidence of this before frequently, and our present reminder occurs in the official account of a recent electrical dinner across the way. "Before entering the banquet hall," says the account, "opporunity was afforded for everyone to meet those whom he did not already know." The carping critic might write whole pages of satire on either of these two extremes. We only wish to collate them. As to which is the more fit and proper, that must essentially depend upon the individual's standpoint. If he goes to a dinner merely to meet old friends the American practice certainly will not appeal to him. In the States, however, business is business, and an American might possibly remind one that if he were merely out for pleasure he would not be attending an official banquet at all. We do not subscribe to this code of conduct in all its primitive robustness, but we should like to see the

effect upon the British personal equation of a visit, say, to kindred societies in Canada. Montreal and Toronto would let us down into the manner of it more gently than Chicago or New York.—Electrical Times.

SMOKE ABATEMENT.

THE arrangements for the Smoke Abatement Exhibition, which is to be held in Glasgow, Scotland, from September 20 to October 12 in order to bring before the public the most scientific devices for preventing the emission of smoke, have now been completed. The exhibits will be grouped in 15 classes—(1) Smokeless fuel; (2) domestic heating; (3) anthracite stoves, gas producers, and other generators of heat; (4) gas fires, condensing stoves, radiators, and gas manufacturing appliances; (5) gas heating, cooking, and laundry appliances; (6) gas water heaters, circulators, and geysers; (7) electric heating and cooking apparatus; (8) heating furnaces and appliances for rooms and buildings; (9) boiler furnaces and appliances; (10) briquette makers, destructors, and refuse consumers; (11) suction gas plant, gas and other power engines, and waste heat apparatus; (12) electric motive power; (13) ventilating appliances; (14) apparatus for preventing emission of dust or grit from chimneys; and (15) shop window lighting, photography with high-pressure gas, gas mantles, baking, and high-pressure gas appliances generally.

The exhibition is being organized by the city corporation with the assistance of the British Electrical and Allied Manufacturers' Association, the Coal Smoke Abatement Society, the Smoke Abatement League of Great Britain, and the West of Scotland branch of that league.

ROBB ENGINEERING CO.

STEPS are now being taken to incorporate and organize a new company to take over the properties of the Robb Engineering Company, Limited, one of the oldest companies in the manufacture of engines in Canada, with headquarters at Amherst, N.S. The company has defaulted in the payment of its assessments and taxes and also in the payment of its bond interest, due on July 1st last. The outstanding liabilities amount to approximately $900,000.

At the request of a large number of the bondholders, Corporation Agencies, Limited, has made an examination of the properties and assets, and has undertaken to organize a new company. The proposal now being submitted to the bondholders is that the new company shall issue 7 per cent. non-cumulative preference shares to an amount which shall not exceed the net amount of the assets of the company, as may be found by an appraisal of its assets by the Canadian Appraisal Company, Limited, and an accounting by Price, Waterhouse & Co., chartered accountants; that is to say, every $100 par value of preferred shares of the proposed new company shall represent new assets of the value of $100. Corporation Agencies, Limited, offers to all the holders of the bonds of the Robb Engineering Company, Limited, to exchange such 7 per cent. preference shares of the proposed new company for bonds of the Robb Engineering Company, Limited, par for par; such bondholders also to receive in cash, at par, the amount of the interest coupons which were payable on July 1st instant, on the bonds held by them respectively. The offer was conditional upon bondholders depositing their bonds to the order of Corporation Agencies, Limited, at any office or agency of the Bank of Montreal by July 30. In the alternative, Corporation Agencies, Limited, offered those holders of the bonds of the Robb Engineering Company, Limited, who did not wish to accept preference shares of the new company, to purchase and pay for their bonds, in cash, at the price of 60 per cent. of their par value, plus the par value of the interest coupons which were payable on July 1st instant.

Trade Gossip

Mr. R. S. Lea has recently removed his office from 405 Dorchester St. West to Room 820 New Birks Bldg., Montreal. Besides conducting a consulting practice of his own, Mr. Lea is associated with **H. G. Ferguson**, 200 5th Ave., New York city, under the name of Lea & Ferguson, consulting engineers, for paper and pulp mill equipment and hydraulic developments. Mr. Lea is a member of the Can. Soc. of C.E., and the Am. Soc. of C. E.

Mr. J. M. Leslie, of the engineering department, Canadian Westinghouse Company, Hamilton, has taken up commercial work in the Toronto office of the same company.

Messrs. Richard Hornsby and Sons, Ltd., of Grantham, England, makers of the well known Hornsby-Stockport gas engine and suction plants, have just opened a Canadian office in the Cartier Building, 212 McGill Street, Montreal, in charge of **Mr. C. H. Anderson.** For a number of years now this firm has been selling their engines in Canada with considerable success and in order to further develop their trade throughout the Dominion this Montreal office has been opened so as to render still more efficient service to intending purchasers in various parts of the Dominion.

The Ideal Packless Valve Co., Walkerville, Ont., inform us that their valves have now been under test for two years, during which time they have given satisfactory service. A large order for Ideal Packless Valves has recently been placed by Toronto users, who, before deciding, conducted a prolonged trial under exacting conditions. Claims made for this valve, are its simplicity durability and comparatively low cost.

Mr. W. G. Walters, late chief engineer at the Whyte pork factory, Stratford, Ont., has resigned his position to accept one with the London Cold Storage Co., London, Ont., as chief engineer there. The new position will have oversight of about 400 h.p. altogether, there being three refrigerator machines each with its engine, and a high-speed engine and electric generator.

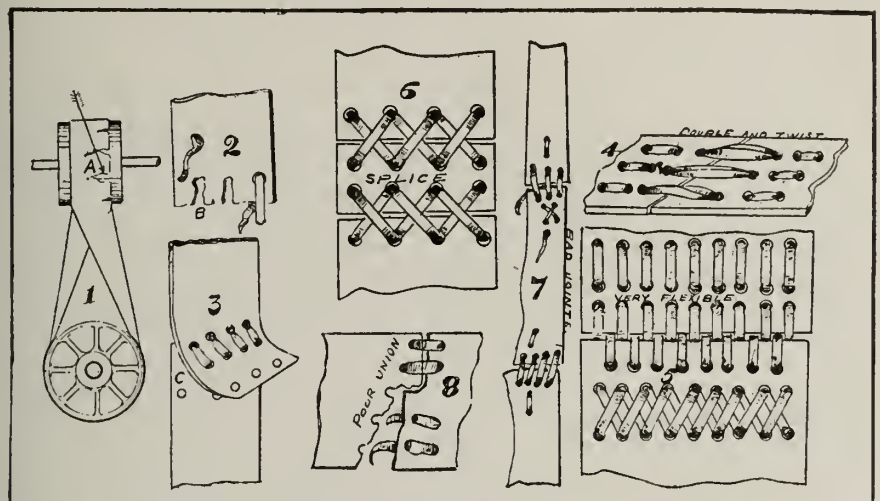
Mr. Walters was in Stratford about eight years with the Whyte factory, it being his second position. His first one was as engineer at Chatsworth, which he held for seven years, going there from his Collingwood home. He is a past president of Stratford branch No. 31 of the C. A. S. E., and last year he was elected honorary president of the exhibitors' association in connection with the C. A. S. E. convention at Stratford.

Mr. Walters has written extensively on refrigeration in the "Power House," and is an expert in refrigeration and kindred subjects. He is an untiring student of his work and an ardent worker in raising the status of the stationary engineer and encouraging his fellow-workers along lines of self-improvement.

Joseph H. McNeil, chief inspector of boilers and chairman of the board on boiler rules of the State of Massachusetts, has resigned to become chief boiler inspector of the Boston department of the Hartford Steam Boiler Inspection & Insurance Co. He was born at Charlottetown, Prince Edward Island, in 1865, and has a wide and valuable experience as an engineer and inspector. He served six years in the mechanical and executive departments of the Prince Edward Island railway machine and boiler shop. He is a member of a number of engineering societies, including the American Society of Mechanical Engineers.

BELTS FOR LUMBER WORKING MACHINERY.

BELTS employed in the operation of woodworking and finishing machinery are exposed to more severe atmospheric conditions than the common belt. Ordinarily, belts are confined within apartments in mills or shops, where there is a fair protection for them; but in the lumber industry one may find belting running in the open, conveying power from an engine established in the woods to the lumber cutting machinery, also not sheltered, except, perhaps, for a crude roof thrown up over them. The belts of exterior lumber cutting service are subjected to rain, sun and dust. These three factors combine to ruin a belt in a few months, unless precautions are taken to overcome some of the troubles. There is often considerable building of sheltered passages for belts in the fixed plant; but when the sawing plant is of the portable character there is not much time or material wasted in erecting covered ways. For these reasons belts of lumber working yards are likely to have numerous defects in them.



Methods of Mending and Splicing Belts — An Elaborate Mend

BELTS FOR LUMBER WORKING MACHINERY.

Fig. 1 shows the manner in which an exposed belt usually breaks up. The constant heating, drying, wetting and chafing of the uncovered leather results in hardening and cracking along the edge as at A. Of course, lubricants can be applied to soften the leather, and these will impregnate the fiber and help to some degree, but even the oils become non-effective as time passes and dust gathers in quantities on the surfaces. The dust hardens and is worn down to a smooth gloss on the wheels and the surfaces of the belting. When a belt gets to the stage shown, it is time to replace it, although the chances are that the new one will go to pieces in a similar way in time. In order to overcome this danger, a covered passageway should be erected.

It is becoming more common to use covered ways for running belts in lumber yards. In some cases, the portable plants are provided with adjustable sheet metal runways through which the belt may be passed when the outfit is set up. Exposed belts decay rapidly at the joints, so that in time the holes may pull out as shown at B, fig. 2. When the holes break out in this manner, the end must be clipped off to present a fresh surface. The holes, however, pull out again, and once more a piece is cut off. This takes some of the leather out each time and makes the belt shorter, necessitating a piece being spliced in. The exposed belt of the lumber yard is liable to break apart at the joints, as at C. fig. 3, because of loosening of the cementing stuffs due to moisture. In order to prevent the joint from severing entirely, a row of lacing is put in, as shown. Fig. 4 shows a triple system of lacing. Six rows of holes are punched and the centre laced with the double twist type of lacing. This distribution of laces would make a firm grip under ordinary conditions; but when a belt is in a weakened condition through moisture and general exposure the rotting leather will pull out at the holes regardless of everything.

The system of lacing shown in fig. 5 is somewhat elaborate. The workman had experienced trouble with the belt breaking at the joint. He had adopted several methods, still the laces pulled out or the ends of the belt tore off. He then devoted considerable time to the complicated belt sewing illustrated. He put a series of holes, all close together, and when he got to the middle he arranged the laces to fit alternately above and below the joint, thereby making a most pliable union.

Fig. 6 is given to show one way employed by the mechanics of a certain lumbering establishment of making a union with a splice piece inserted. It will be noticed that the crosses are confined to one side. Often in inserting a piece in a belt to make up for the bad ends that have been clipped off, the laces are made straight and crossed on the same side. This mixture of straight and crossed laces always develops trouble.

In fig. 7 is shown the kind of belt that should be avoided, for the reason that it is patched and remade in places. In case a belt has to be used after it is patched a number of times, pains should be taken to have the joints cut evenly and laced. If the splice is uniformly made, it should not hinder the run of the belt; but if the splices are poorly made, as in this figure, the belt will give endless trouble. Belts in use on struggling machines like this are sure to militate against the performance of good work. Often belts on important machinery in lumber yards operate in as bad condition as shown in Fig. 8. In case a belt thus united has much work to do, the strain will quickly tear open the union; but if the work is light the patched joint may run on indefinitely, but giving poor service.—American Lumberman.

AN OPEN LETTER TO THE C. A. S. E.

Stratford, August 12, 1912.

Brothers:

You will notice in our Annual Convention Report the adoption of new measures, which will, I believe, be the most important part of our programme for the ensuing year.

The Executive have appointed an Educational Committee to adopt a series of questions and answers, whereby our members will be officially educated in all of our local lodges. The Executive hope to be able to present to all lodges a certain number of copies, and trust that all members will take a deep interest in them, as they have only been adopted after long and strenuous work. I thank all for the honour conferred on me by the members of the C. A. S. E. in appointing me their executive secretary for the ensuing year.

Trusting that my efforts will be augmented by every individual member, so that we may get in touch with every progressive engineer, thereby guaranteeing a banner year for the C. A. S. E.,

I am, fraternally yours,

A. KASTELLA,

Executive Secretary.

SUN POWER STEAM ENGINE.

AN engine utilizing steam at less than atmospheric pressure has been developed to furnish power from the steam generated by the heat of the sun in a plant built by the Sun Power Co., Tacony, Philadelphia, Pa. The component parts of this plant are the absorber, the engine, the condenser, and the necessary auxiliaries. In a general way, the absorber is composed of a series of units, each containing a flat metal honey-comb water vessel, rectangular in shape and closely resembling in appearance a large waffle. This vessel is enclosed in a flat wooden box covered with two layers of glass having a lin. air space between them, and the under surface of the box is protected from loss of heat downward by a layer of cork 2 in. thick and two layers of waterproof cardboard. These boxes are mounted on supports which raise them approximately 30 in. above the surface of the ground and enable them to be inclined perpendicular to the sun at the meridian; the adjustments of the inclination being made approximately once in three weeks. On two sides of the box are mounted plane mirrors so that it is possible to absorb more rays of the sun and reflect them on the surface of the water vessel. This vessel is connected at one end to a feed pipe from the water supply and at the other to a steam pipe.

The steam pipes from the various units are connected together and enter a main 8 in. diameter which conveys the steam to the engine. The engine is of the four-valve type and has a cam-operated valve mechanism arranged to open and close very rapidly. The total clearance space is approximately 1 per cent. of the piston displacement and the valves are placed so as to make the losses due to clearance a minimum. The cylinder diameter is 24 in., and the stroke is also 24 in. The engine is double-acting, with the admission valve seats on the barrel of the cylinder near the end and exhaust valve seats in the heads. In general appearance it does not differ from others of the same size (20 h.p.), except that the working parts are light and the connecting rod is rather long . It is connected to a condenser of the ordinary type and has auxiliaries such as will be regularly found in any condensing plant. The water from the condenser is pumped back into the absorber, thus insuring a continuous closed circuit, and the only water loss, it is stated, is that due to accidental leakage.

Test Data.

Several tests were made of this engine by Professor R. C. Carpenter, Cornell University, Ithaca, N.Y., and it was found that with steam about 1 pound above atmospheric pressure and a vacuum of 28 in., the engine required about 31.6 pounds of steam per b.h.p., but with the vacuum increased 0.8 in., the steam consumption was 28.8 pounds. Numerous other tests made with a steam pressure approximately 8 pounds, or 6.75 pounds below atmospheric pressure gave a steam consumption of 37.8 pounds with a 27 in. vacuum and 35.7 pounds with a vacuum of 28.66 in. A comparison of these results with the Rankine cycle gives efficiencies varying from 43.8 to 52.4 per cent., depending upon the load and the steam pressures.

ENGINEERING CLASSES IN WINNIPEG.

THE annual short courses in steam and gasoline engineering, which are being held for the fifth time, closed on June 28. The total number in attendance was sixty-two, most of whom are residents of Manitoba, while not a few have come all the way from Saskatchewan, and the class included men of all ages from 17 to 45. Thirty students received instruction in steam engineering under the direction of Professor L. J. Smith, B.S., assisted by R. Milne, B.S.A., and thirty took the gasoline engine course, under W. J. Gilmore, B.S., who is assisted by Russell Rice. These courses are carefully planned with the object of aiding, not only those who have already acquired some knowledge of steam or gasoline engines, but also those who have had no previous experience in their operation, and who realize that such knowledge is essential to success in modern farm management. The large engineering building at the Agricultural College is well equipped for the teaching of a practical course of this kind. It contains steam and gasoline engines, testing apparatus, valve models, and other appliances necessary for demonstration work.

In addition to the engines already at the College, arrangements have been made with the large tractor firms to have at least ten different tractors sent up for use during the latter part of the course, so that the students will have an opportunity of handling and becoming familiar with the various types of engines on the market.

ALTERNATING CURRENT RAILLESS TROLLEY.

ACCORDING to the Electrical Review, the first alternating current railless trolley in the world is being shown in working order on a tar macadam road, by the Gesellschaft fur Gleislose Bahnen Max Schliemann & Co., at the Electrical Exhibition of Leipzig. This is an electric omnibus traveling on a strip of tar macadam 100 feet in length, which has been rolled on an existing uneven stone pavement 6 cm. in thickness, after scratching out the joints as far down as possible. The omnibus is operated by a 1000-volt single phase commutator motor of 15 horsepower output, 1,200 revolutions per minute, 50 cycles, which is started and controlled by shifting the brushes.

The motor drives the rear axle through a double cardan shaft and a worm gear of 10 to 1, and the rear wheels by an elastic clutch. The form of current, the voltage, and the use of a repulsion motor constitute decided novelties in this connection. The rubber tires are guaranteed for 20,000 kilom., but 40,000 kilom. have been reached in actual operation, corresponding to a cost of 1 cent per kilom. The vehicle is lighted by metal filament lamps. The speed is 20 kilom. per hour, the average consumption being ½ kilowatt-hour per kilom.

WEAR IN STEAM TURBINES.

IT is frequently claimed for the steam turbine that its initial efficiency will be maintained, whereas the steam engine, due to wear producing leakage of the piston and valve and derangement of steam distribution, will rapidly deteriorate. It is said that the erosion of the blades of the steam turbine will produce changes in the direction and conditions of the entry of the jet which have a serious effect upon the efficiency. Temperatures over 250 deg. Cent. (482 deg. Fah.) may totally destroy bronze blades in from two to four years. Nickel steel with 25 per cent. nickel has been found to be unusable. The best metal for blades is nickel steel with 5 per cent. of nickel. The lateral wear of the bearings has also a detrimental effect upon the efficiency. The duration of the blade is considerably greater with lower steam velocity. With a turbine of 500 kilowatt capacity, running at 3,000 r.p.m., after 29,700 hours of operation with a production of 8,350,000 kilowatt-hours the steam consumption had increased about 27 per cent. A Curtis turbine of 1,000 kilowatts capacity, running at 3,000 r.p.m., with bronze blades, working at only one-half or three-quarters capacity, after 31,000 hours of running and a production of 17,800,000 kilowatt hours had an increased steam rate of about 18 per cent. In the case of a Zoelly turbine of 1,000 kilowatts capacity, 19,500 hours of operation and a production of 13,160,000 kilowatt-hours resulted in an increased consumption of about 3 per cent. It would appear that in order to maintain the initial efficiency of a turbine it may require occasional, if not frequent, re-blading.

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A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. VI. AUGUST, 1912 No. 8

NOTICE TO READERS.

THE kind indulgence of subscribers is requested concerning editorial omissions or imperfections in the current Issue of "The Power House," in view of the fact that bereavement in our editor's family, following an extended period of sickness, has prevented the usual attention being given the selection and disposition of the contents.

THE 1912 C. A. S. E. CONVENTION.

THE recent convention of the Canadian Association of Stationery Engineers at Belleville, Ont., was as usual a highly successful social function. In addition to this, however, gratifying reports of increased financial stability and determined and sustained efforts in the direction of concentrated educational activity for raising the personnel and extending the general work of the Association, fall to be recorded.

It was a matter of regret that the representation of engineers at this Convention fell altogether below expectation, and while we appreciate the fact that much difficulty exists whereby engineers can get relief from duty for three or four days it surely is not impossible of attainment to have matters arranged so that in future more men would have the opportunity to avail themselves of coming into personal contact with their Executive, their fellow members, and through the Exhibitors' Association with new developments and attractive features of power plant equipment and appliances. We would suggest to the Executive that some additional consideration be given this aspect of the situation, for while we are fully aware of the important place that the engineer fills in our factories and power plants, it should be no impossibility for him and his employer to anticipate the eventuality of a few days absence from duty. We are fully convinced that every employer would gladly consent to any such arrangement, particularly as the results to him would be beneficial in equal measure to that derived by the engineer.

As has been stated in these columns on previous occasions, the C. A. S. E. is not the force in Canada that its name and title warrant; as a matter of fact these latter are much too comprehensive for the limited field embraced and brought within the activities of the Association. The inclusion of a large number of men, although tried men on the Executive Board for 1912-13, gives expectation that possibly there may be an advanced programme of well balanced and effective work undertaken. At the same time, the labors of the men, now retired, but who have borne the burden and heat of the day, may not be under-rated or depreciated, for while progress in the past may not have been as rapid as some could have wished, it should not be forgotten that there may have been achievement accomplished by holding their ground steadfastly. The Canadian Association of Stationary Engineers owes much to W. A. Crockett and A. M. Wickens, and we are right in saying that their retiral from active participation in the management of the C. A. S. E. will neither mean a lessening of interest nor unacceptance of invitation or opportunity that may present itself to further the work.

Reference has already been made to the advantages derivable by engineers from studying and investigating the exhibits put forward by the Exhibitors' Association, and to pursue the subject somewhat further, let us say that a keener interest is advisable. This Exhibitorrs' Association, while naturally largely interested in the propagation of the special features of its manufacturers with a view to securing sales, and these, of course, through the instrumentality of the engineers, is at the same time carrying on a highly educative and instructive campaign at more or less expense, and we believe it to be our duty to put the issue before the C. A. S. E. delegates and others so that they may appreciate this adjunct to their work at its true and proper value. We are constrained to believe that a keener interest in the exhibits during each convention period on the part of visiting engineers would be welcomed by the exhibitors, collectively and individually.

While referring to the Exhibitors' Association, it may be worthy of remark that the annual meeting for the election of officers, and the transaction of general business was notable for a large and representative attendance. As in the case of the C. A. S. E. executive, a large sprinkling of new blood found its way into the general official body and it may not be gainsaid that a judicious blending of the old and the new will produce good fellowship..

Lodge 34 C. A. S. E. is to be congratulated on its work of acting host for this convention and exhibition, and the citizens of Belleville who gave of their substance to assist the local society in keeping up the honour of the Old Town, look with pleasure and pride on the successful outcome of the whole function.

THE COMING WINTER.

AN open letter, relative to the educational scheme suggested by the C. A. S. E. executive, for action by each individual lodge, is to be found in another part of this issue, and in view of the flight of summer and the approach of the shortening days of early fall, it behoves engineers to study the proposition put forth, and make arrangements to carry the course of instruction through without faltering.

GAS AND OIL ENGINE PROGRESS

A record of principles of design, construction and achievement in a rapidly developing sphere of power generation.

BITUMINOUS COAL PRODUCERS.

By C. M. Garland, Camden, N.J.

THE present article is the concluding portion of the paper read recently before the American Society of Mechanical Engineers, the introductory part having been published in our July issue.

The Fuel Required.

It can almost be safely said that any fuel can be used in any well designed producer of the up-draft type. If the fuel cannot be used, the probabilities are that the fault is either in the operation or in the design of the producer. The reason for this is that there are but three fundamental requirements for the successful gasification of a fuel. These are, uniform distribution of the blast, uniform distribution of the green fuel and uniform removal of ash. These three are essentially one as they are so closely related and interdependent that they conduce to uniform distribution of the blast. When these requirements have been met in the design of the producer, the writer has never found a fuel that could not be gasified, at much higher rates and with much less labor than is considered possible by the majority of engineers.

Producer Plant Costs.

The cost of producer plants and of operation are by no means fixed quantities, so that it is very difficult to give figures that are general and that can be safely applied to any and every case. Each plant requires individual consideration in order that no mistakes or misunderstandings may arise. It is therefore with some hesitation that the following figures are given:

First Cost—The first cost depends upon:

A—The service or load conditions; that is, continuous, intermittent, or variable load, and the magnitude of the load. These determine the necessity for duplicate or spare apparatus and the number of units into which the plant should be divided.

B—Upon the design of the producer. With a given fuel, one type of producer may gasify 50 per cent. more fuel than another type, or one type may be capable of continuous operation, while still another may require a light load during the period of the removal of ash.

C—Upon the method of generating steam for the blast. That is, whether or not the producer generates its own steam supply or requires that this should be generated in separately fired boilers, either direct fired or exhaust fired. Where the producer generates its own steam supply, the first cost of the producer plant is, as a rule, much less expensive than the installation of either direct or exhaust-fired boilers.

D—Upon the characteristics of the fuel. One fuel may be gasified at a much higher rate than another, thus reducing the size of the producers required.

E—Upon the percentage of ash. With low percentage, a plain water-sealed producer is satisfactory. With percentages above 12 or 15 per cent. a rotating table and cone bottom become desirable in order to reduce the labor costs.

F—Upon the scrubbing apparatus required. This depends upon the amount of volatile matter in the coal, and the characteristic of the products resulting from the volatile matter which appears in the gas.

G—Upon the method of handling the coal.

H—Upon local conditions.

Operating Cost.

The operating costs are very intimately connected with the first cost and depend upon:

A—The character of the fuel. Some fuels require a greater amount of labor than others.

B—The design of the producer. A properly designed producer will require much less labor than a poorly designed producer when operating on a given fuel at a given rate of gasification. In some instances small changes in the arrangement of the admission of the blast to the producer have reduced the labor required to operate at least 50 per cent.

C—The amount of ash contained in the fuel.

D—The coal-handling machinery.

E—Facilities for handling the tar.

F—Supervision. In every instance where the plant is under the direction of a man that understands the apparatus and has given his thought to the operation, the operating costs are greatly reduced.

G—Local conditions.

In order to analyze the different costs and indicate their approximate magnitude for pressure plants ranging in size from 500 to 1,500 b.h.p., a proposition will be assumed wherein it is required to develop from bituminous coal of known properties, approximately 1,200 net b.h.p. in excess of the power required to operate the producer auxiliaries. It will be assumed that the load conditions are such that three units are desirable and the costs will be based on full load operation 365 days per year, 24 hours per day. From these costs the effect of various load factors may be investigated.

The following assumptions will be made:

Coal ....13,500 b.t.u. per lb. calorimeter determination or high value	
Cost per ton delivered	$1
Per cent. volatile matter	32
Per cent. ash	8
Efficiency of the producer based on the effective heating value of the gas, per cent.	62.7
Effective b.t.u. required by the engines per b.h.p. at full load	10,500
Effective b.t.u. per lb. of coal $\frac{13500 \times 62.7}{100}$	8465
Lb. coal per b.h.p-hr. $=\frac{10500}{8465}$	1.24
B.h.p. required for tar extractor	30
B.h.p. required for fan blower	5
B.h.p. required for scrubber water pump	5
Total auxiliaries	40
Total b.h.p. required	1240
Total lb. coal per hour=1240×1.24	1538
Area of fuel bed required at 10 lb. gasification, sq. ft.	153.8
Three producers 8 ft. inside diameter will be required. These would have a continuous overload capacity of 25 per cent. and 50 per cent. for three hours.	
Area of fuel bed of each producer, sq. ft.	50.26

Each producer should be of the water-sealed type for continuous operation since the fuel is a bituminous coal of medium grade containing a fair amount of ash. The steam for the blast may be obtained by the use of a superimposed vaporizer, a vaporizer placed between the producer and the scrubber, an exhaust boiler or an independently fired boiler. The latter is very uneconomical and has a high initial cost, so that it is not used in power work at the present time. The exhaust boiler is eco-

nomical, provided there is no other use for the steam that may be thus generated. The first cost is, however, high, and as in many cases it must be located at a distance from the producers and requires more or less attention, its use in plants of this size and for this purpose is hardly justifiable. The vaporizer or boiler between the producer and scrubber, while an excellent arrangement for anthracite plants, is unsuitable for bituminous coal plants on account of the solid matter that is carried in the gas. The superimposed vaporizer therefore remains as the last choice. This is low in first cost and while it absorbs a certain amount of radiant heat from the fuel bed, which could otherwise be utilized, it is convenient, requires little or no attention and essentially no repairs, so that for small and medium sized bituminous plants it is the most economical method of generating steam for the producers, and will therefore be selected.

To each producer a static scrubber will be connected, as shown in Fig. 1. These scrubbers will in turn connect to a water-sealed gas main. Since the plant is to operate continuously, two tar extractors and two fan blowers will be required, one of each for a spare. The tar extractors and fan blowers should be driven by electric motors direct connected; 35 or 40-h.p. motors will be required by the former, while 5 or 7½h.p. motors will be required for the latter. The coal-handling apparatus will consist of a 30-ton coal bin located above the second producer which spouts to the coal hoppers of each producer. A track bin will be located near the producer house and an elevator used for delivering the coal from the track bin to the 30-ton coal bin above the producers. The ash removed from the water seals of the producer will be loaded into a small car which may be hoisted into either a railroad car or ash wagon by means of a block and tackle or an air lift. The building will be of steel frame construction with corrugated iron sides. A charging platform will be built around the producers.

For an equipment of this nature, the cost of the producers and auxiliary apparatus erected on the foundations, including the charging platform but not including freight, will be approximately:

Per b.h.p. of the engine	$11.20
Foundation per b.h.p. of the engine	0.48
Coal handling apparatus per b.h.p. of the engine	1.42
Building 50 ft. x 45 ft. per b.h.p. of the engine (not including land)	2.25
Total	$15.35

The operating costs* may now be taken as follows:

Interest, depreciation, taxes, insurance at 13 per cent. per annum per b.h.p-hr. (8760 hr. per yr.), cents	0.02280
Maintenance and repairs, this may be taken at 1½ per cent. of the first cost per annum, cents	0.00270

*Computations have been based on the brake horsepower of the engine and on coal at $1 per ton of 2,000 lb. This basis would seem to make the figures most easily applicable to different conditions of load and fuel.

The item of supplies is a variable one and depends somewhat upon the behavior of the fuel. If it is a clinkering fuel, the cost of bars for poking in itself may amount to quite an item. The total should not amount to over $200 per annum for average conditions, or 0.00185 cents per b.h.p-hr. Labor is also a variable quantity, depending upon the behavior of the fuel, upon the management and upon the amount and kind of coal, ash and tar handling apparatus installed. In the case of the present plant, and with a fairly good fuel, three men per shift of 12 hours should handle the plant with ease. The price for labor varies with the location, but $3 per day for the chief operator and $2 per day for his five assistants is ample. This makes a total of $4,745 per year, or $0.0437 b.h.p-hr. The cost of the fuel has been taken at $1 per ton and at full load, the coal per year will be

$$\frac{1538 \times 8760}{2000} = 6745 \text{ tons or } \$6745, \text{ or}$$

0.062 cents per b.h.p-hr.

We have, therefore,

	Per B.h.p-hr. cents.
Interest, depreciation, taxes, etc.	0.02280
Maintenance and repairs	0.00270
Supplies	0.00185
Labor	0.04370
Fuel	0.06200
Total	0.13305

The total cost of operating the producer equipment at full load is 0.133 cents per engine b.h.p-hr. If it is assumed that the gas generated has an average low calorific value of 136 b.t.u. per cubic foot of standard gas,

$\frac{8465}{136}$ = 62.2 cu. ft. will be generated per lb. of coal and $\frac{10500}{136}$ = 77.2 cu. ft. will be required per b.h.p.

1000 cu. ft. of 136 effective b.t.u. gas will cost, therefore, 1.72 cents. This, as above noted, does not include the cost of land for buildings, freight, nor the cost of scrubber water, which in many cases is obtained at the cost of pumping.

From the above figures, the cost of power for any given load factor may be obtained and for any given cost of fuel. The power required by the producer auxiliaries remains practically constant, also the fixed charges and labor, unless in the case of the latter, the load factor is sufficiently low to dispense with one producer operator per shift. The only variable is therefore the amount of coal used which may be determined from the number of hours of operation and the heat consumption of the engine at different loads, on the assumption that the producer efficiency is constant at all loads from 25 per cent. to 1.25 per cent.

Future Developments.

Plants of the type described have proved reliable and economical in practically every case. Particularly is this true for plants operating on poor fuels, like the lignites, and plants operating on high priced fuels. The economy obtained depends, however, to a large extent upon the intelligence displayed in the operation and in the design of the plant.

The future for these plants is also promising, as more economical results are now recognized as obtainable through the following improvements which reduce the first cost of the plant and also the operating costs:

A—Increase in the rate of gasification.

B—Decrease in the power required to drive the cleaning apparatus.

C—Utilization of waste heat.

Increase in the rate of gasification has been made possible by a careful study of the effect of the distribution of the blast on the operation of the producer.

The writer's experiences, in a study of the operation of a large number of producers on bituminous, semi-bituminous, lignites, anthracites and semi-anthracites, have led to the complete realization of three fundamental requirements that must be met in the successful gasification of all fuels as previously set forth, viz:

A—Uniform distribution of the green fuel.

B—Uniform removal of ash.

C—Uniform distribution of the blast.

A study of the producers on the market to-day will reveal the fact that there are few, if any, that meet all of these comparatively simple requirements. A few have partially done so and have proved successful at low rates of gasification, or at high rates on certain fuels. From this study and investigation it has become apparent that average fuels can be gasified at rates from 50 to 150 per cent. greater than the present rating of producers (9 to 10 lb. per sq. ft. of fuel bed per hour), and with no increase in labor. This means a great reduction in the first cost of producer plants and also in the operating costs. Furthermore, the same principles produce the same results in large producers as in small producers, so that it is just as practicable to build a producer of large as of small diameter, while the labor per square foot of fuel bed required in the operation of the producer, the first cost, and operating costs are greatly reduced. The

writer's experience would indicate that producers up to 15ft. inside diameter are practical.

Utilization of Waste Heat.

Utilization of the waste heat is an item that has received some attention in the past, but not as much as it warrants. As a rule, the average gas plant is extremely wasteful of heat. About 12 per cent. of the heat in the fuel is thrown away in the scrubber water, while about 60 per cent. is thrown away in the cooling water to the engine cylinders and in the exhaust. These last two quantities are available for steam raising in the bituminous coal plant. Approximately 2½ lb. of steam can be generated per b.h.p. of the engine. Where there is a fairly uniform load and a demand for this steam, it can be obtained at a comparatively small cost, and when credited against the cost of gas at the same rate as the cost of steam by direct firing, reduces the cost of gas from 12 to 20 per cent. If there is no demand for steam for heating or other purposes it may be used for the generation of power either in engines or turbines.

For good economy, the exhaust boilers should be of the low-pressure self-contained type, generating steam under about 5 or 10 lb. pressure. The heating surface should be approximately twice the amount per b.h.p. as that used in direct-fired boilers. It should not, however, be sufficient to reduce the temperature of the leaving gases below 220 deg. fahr., unless a cast-iron boiler is used. Boilers for this purpose can be made practically automatic in operation, and as a rule can be attended by the engine-room operators, so that there is essentially no additional cost involved.

SEMI-DIESEL ENGINES.

So much attention has been paid of late to the Diesel oil engine that the claims of the so-called semi-Diesel type have been somewhat overlooked. It is of comparatively recent date that the practical utility of the latter type for small powers has been realized at all, and only a limited number of engineers are manufacturing or experimenting with such engines in Great Britain. Continental firms have been the pioneers in this case as in so many others, and one Swedish firm who built semi-Diesel engines on a very large scale are said to be refusing orders owing to the impossibility of turning them out quickly enough.

Principle of Operation.

The term semi-Diesel is in reality a misnomer, for the engines work in a very different principle from that of the Diesel engine, although the two are alike in the fact that they are capable of using heavy crude oil as fuel. The difference between them may be briefly described as follows:—In the cylinders of Diesel engines the air is first compressed to a very high pressure (from 40 to 50 atmospheres) and, near the termination of the compression stroke, oil is injected by means of a charge of compressed air supplied by an auxiliary air pump. The mixture is then ignited by the high temperature created by the high compression. In the case of the semi-Diesel engine the compression pressure is moderate (generally about 150 pounds per square inch), and oil alone is injected, the charge so formed being fired by the heat retained in the walls of a "hot bulb," the temperature of which is maintained by the combustion of previous charges.

Owing to the comparatively low pressures and temperatures employed in the semi-Diesel engines, most of the cylinder troubles experienced with the Diesel type are eliminated. The necessity for making the working parts of exceptional strength is also avoided, and no separate air compressor with its attendant complications is required. In fact the most noticeable feature of the engine is its extreme simplicity. A single-cylinder engine has only three working parts, exclusive of the fuel pump and the governor, whereas in the case of an ordinary four-stroke paraffin engine there are at least ten such parts and often many more. The operation of the engines is equally simple; they work on the two-stroke cycle, so that there is an impulse for every revolution of the crank-shaft. There are no valves, the distribution of the gases being effected by means of ports opened and closed by the movement of the piston. The oil having been injected and ignited in combination with the air already compressed in the cylinder, as described above, rapid combustion takes place. This creates the pressure for the working stroke, which continues until the piston passes and opens the exhaust port, permitting most of the exhaust gases to escape to the atmosphere. During this working stroke, air is simultaneously compressed on the under side of the piston within the crank chamber, and immediately after the piston has passed the exhaust port it uncovers the air port, allowing the compressed air to travel from the crank-chamber to the cylinder. At this point the piston is moving comparatively slowly and the incoming air sweeps out most of the residue of exhaust gases through the exhaust port and fills the cylinder with relatively pure air in readiness for the following compression stroke. With certain oils it is found necessary to inject a little water into the cylinder along with the air, in order to assist the internal cooling of the cylinder and to prevent the excessive deposition of carbon.

For starting the engine, the bulb on the cylinder head is heated for a few minutes by means of a blow lamp. Speed regulation is generally effected by means of a governor in combination with a variable stroke fuel pump.

Size and Running Costs.

The semi-Diesel system has so far been adopted for moderately small powers only; the largest engine at work within the writer's knowledge is of 120 b.h.p., this power being derived from two cylinders of 60 h.p. each. Engines have been made, and are successfully running, at so low a power as 7 h.p.

Owing to their simple construction, they can be built at a cost something like 30 per cent. less than that of any other type of oil or gas engine. This coupled with the fact that cheap fuel can be used, will undoubtedly in due course render them serious rivals of the small stationary gas and oil engines at present in the market, at any rate up to those powers for which it is worth while to install suction gas plant. They are suitable for any commercial purpose, and in marine work they supply an excellent form of power for the smaller sizes of craft, such as fishing and canal boats, owing to their simplicity, flexibility, comparatively low cost of running, and the facility with which they can be reversed without the usual reversing gear.

So far as fuel economy is concerned they are inferior in thermal efficiency to the Diesel engine, but compare very favorably with other types of small explosion engines. For example, a 10 b.h.p. semi-Diesel engine will use about 0.66 pound of crude oil per b.h.p. per hour. Therefore, if the normal price of crude fuel oil be taken as about $12 per ton, the cost of working such an engine is approximately 3½ cents an hour for fuel. The fuel costs of these engines, however, become comparatively unimportant when the first cost, cost of upkeep and repairs and renewals are taken into consideration. They show remarkable flexibility under varying loads, and one recently tested with Scotch shale oil having a specific gravity of 0.85 was found to work equally well at full load and no load at all.—T.E.S.

London, Ont.—The bursting of a cylinder head in the refrigerating plant of the McCormick Mfg. Co., London, Ont., Canada, June 4th, caused considerable inconvenience from escaping ammonia, but no serious loss otherwise.

Birth and Development of the Steel Works Engineer*

By A. L. Hoerr

The writer deals in an attractive manner with the rise to his present highly-respected position of the once more or less despised steel works chief engineer. The "Practical Men" used formerly to turn up their noses at the technically trained engineer and his staff of draftsmen; but that state of affairs is now a thing of the past. The paper incidentally gives many useful hints as to the economical operation of a rolling mill.

THE writer's experience began at a time when the rolling of steel was done to a large extent on mills that had been designed to roll iron, and were, therefore, not suited to the new requirements. Even newer mills, designed for the service, were often inadequate, partly because of the inexperience of the designers and partly because the demands of the business grew so rapidly that the mills could not be kept in line with them. The constant demand was for tonnage. Day by day this demand grew and the mills had to satisfy it. New and larger sizes of standard shapes were added to the rolling schedules as well as entirely new shapes; and as a result of these conditions, breakdowns were very frequent.

The Old Time Mechanics.

The men in demand were the master mechanics and their millwrights. Having been trained only in the hard school of experience, they knew little of books or calculations. Time in many cases could not be taken to determine the exact cause of a break, and the only remedy applicable was to make the new part stronger than the old. That this might and often did cause breakage in some other part of the mill or machine, could not be foretold, the main point being to get things going again as quickly as possible.

Foundations for new buildings or extensions, for shears, tables and other machinery were located in the field by means of a carpenters' chalk line, a straight edge, and a spirit level. The new building was planned about parallel to some existing building or track, but seldom with any thought of what might be needed in the near future.

Much of the machinery was designed in the pattern shop, and drawn full size on large built-up boards. Pattern-makers and machinists worked to these drawings and when the job was completed the drawing was erased with a plane and everything was ready for the designer once more. Repair parts were obtained by having someone who remembered the job, visit the pattern storage house and by the aid of some mysterious sense of direction, pick out the pattern. The machinist went to the broken or worn out parts for his sizes and very frequently got them right.

Improved Methods Evolved.

The mechanical men of that period deserve great credit for the work they did for the steel mills. Without engineering education or elaborate mechanical equipment, they designed and built the plants that earned the money to pay for the successive steps to our present efficient installations.

As larger mills were built, with elaborate mechanical mill tables, shear tables and cooling beds, the need of a more orderly system of working became apparent. In some cases, the master mechanic arose to the occasion and changed his methods, becoming, in fact, the engineer. In most cases, however, he leaned more and more heavily on the once despised draughtsman. The mechanical men could no longer take time to pick out the patterns, for there was other and more important work for them to do. The number of units in the plant had grown greatly, with a corresponding increase in the number of spare parts previously carried, and accurate drawings became a necessity. There had always been a few draughtsmen stuck in some dark corner of the plant, but they were not counted as of much importance. They were usually referred to in rather disrespectful language by the mechanical men, and if the truth be told, they often deserved it. The new conditions made necessary the employment of a large force of draughtsmen and also the organization of a field force to survey the ground, lay out the foundations for buildings and machinery, and supervise all construction.

The engineer, with this organization under his control, became a man of greater importance in the plant. He was called on to assist in many ways in the systematizing of numerous plant operations, beginning with a proper marking of his own drawings, and extending through the pattern shop into the foundries, machine shops and other finishing departments. Men from his department were detailed to follow the orders through the shops, expediting the transfers from one shop to another, interpreting drawings and making such changes as the development of the work made necessary. He could no longer be the designer of machinery for someone else to build, but on the contrary he must study carefully all of the processes involved and adapt his design to the facilities available.

In the field all locations for buildings and machinery were now carefully selected with regard to the future and many surveys and studies were made before excavations were started. In order that operations at widely separated points should have a definitely known relation to each other, standard base lines and elevations were established from which all surveys started. In many places the power end of the plant engineering grew up as a department distinct from the general engineering, while in other places they grew up together. In any case the problems were unchanged.

Power Plant Equipment.

The old equipment usually consisted of tubular boilers, simple, non-condensing engines and simple direct acting pumps. The electric power house was almost unknown except for a few belted arc machines. The boilers were all hand-fired and the ashes were taken out in wheelbarrows or carts. Coal was cheap and nobody objected to the smoke, which was accepted as the one best sign of prosperity. Into the midst of these conditions the engineer was projected in the course of his progress through the plant. The demand was not so much for changes which would save fuel as it was for changes that would make it possible to pull the loads with the existing engines and to get from the boilers enough steam to enable them to do it continuously. To meet this demand it was necessary to systematize the operations in the steam department. The firing of coal, cleaning of fires and blowing down the boilers in the various groups, were all arranged so as to interfere as little as possible with the production of a regular supply of steam both as to quantity and pressure. The boilers were cleaned more regularly and more thoroughly, and were carefully ex-

*Abstract of paper read recently before the Western Pennsylvania Engineers Society.

amined for both steam and water leaks. Steam pipe systems which had grown with the works and had been extended in all directions without any calculation as to pressure drop, were reconstructed so as to give shorter runs to the various consuming points, thereby making available a higher average steam pressure. This, together with the adjustment of valves so as to balance the work in the cylinders and reduce the back pressure, gave a new lease of life to many engines, apparently antiquated.

Introduction of Stokers.

As additions to the plant were made, water tube boilers and automatic stokers were introduced, sometimes with the mechanical ash handling machinery, frequently without. Compound engines were adopted with much hesitation at first, and in many cases were operated for years without condensers. Later, condensers were added, and until the advent of the low pressure turbine this was considered the most economical steam using combination possible. Some engineers maintain that this is still true.

The power plant grew greatly in size as motors replaced engines for driving the smaller auxiliaries in the plant, including the driving of shops, cranes, mill shears and tables, and the problem of the economical generation and transmission of electric power became of prime importance.

The reciprocating steam engine had this field to itself for a long time; but the high pressure turbine, the large gas engine using blast furnace gas and the low pressure turbine, have entered the field, in the order named, and are making strong bids for favorable consideration. Each, no doubt has its place, it being the engineers' duty to determine when and where they can be used to the best advantage.

Economizers and superheaters for the steam plant have been used rather sparingly; but the tendency now is to figure on them very generally, especially in connection with the utilization of waste heat from various metallurgical operations.

Engineer and the Power Plant.

In the plants where these various fuel saving devices were installed, it was quickly learned that their efficiency could only be maintained through constant and watchful supervision. It was not sufficient to instal a feed water heater; it was necessary to learn the water temperature from day to day. It was not sufficient to instal a compound condensing engine, it was necessary to indicate it at intervals to see that the load was properly distributed between the cylinders and that the condenser was maintaining a minimum back pressure on the low pressure piston. All other equipment required similar watching to see that its original economical operation was maintained. In some cases, as previously mentioned, the master mechanic assumed this new work and carried it on successfully, but in most cases it passed to the engineer. As there was no important part of the works that did not use steam, water or electricity, and as the engineer was now largely responsible for their economical production and distribution, there was no important phase of the plant's operation with which he was not brought in close contact. Although still looked upon by the so-called practical man as somewhat of a dreamer, he had an established place in the plant and was doing a work which became of more importance every day.

To-day the power problem is being given careful and detailed consideration in many large plants by separate engineering departments, organized for the purpose of collecting and interpreting data. These studies are of value for many purposes; among others, to determine the conditions under which most nearly continuous operation is assured; to determine the conditions for most economical operation; to aid in accurately determining costs of various products by a proper distribution of steam, water, electricity, etc. to the various departments, and to accumulate in available form, data from which the merits of proposed new equipment can be judged.

Power Plant Records.

To this end records are kept of the steam and water pressures, of the condenser pressures, of the temperatures of boiler feed water and of condenser water, of the weight of coal and water supplied to the boilers, of packing and pump valve service, of lubricating costs, and in short as nearly as possible of all variables that affect the operation of the plant. The records are supplemented by records of numerous boiler, engine and pump tests made under operating conditions. All of these data are then available for study by interested parties, either to throw light on certain cost sheet items or in connection with changes in equipment.

That the engineer has reached the limit of his development in plants of this character, the writer does not believe. Many men of engineering training and experience have reached important executive positions, and there are many reasons for believing that many more will do so in the future.

Expression has been given, however, more and more frequently of late, to a belief that will do much to prevent this. It has appeared in the engineering press and is frequently heard in the conversation of engineers. It is to the effect that the engineering profession is not properly recognized; that it does not receive financial rewards commensurate with the services performed, and that it does not receive the recognition in civic affairs which its interests demand and which its abilities merit. Much of this matter has about it a melancholy, disheartening sound. It professes belief in a most distressing state of affairs, blames it all on someone or something outside of the engineering profession, and looks for relief through some mysterious awakening of the other fellow which will enable him to see the engineer as the engineer now sees himself.

In the writer's opinion there is very little reason for such expressions and the instances in which conditions seem to be as represented, are almost entirely the fault of the engineers themselves. Financial rewards come to those who have for sale that which is in demand. It is not sufficient that a man be familiar with the laws of physics and mechanics or be able to calculate stresses in structures or solve problems in thermo-dynamics. Such knowledge is necessary for the engineer, but he may have it all and still be a mere calculating machine, differing from others only in height, weight or in the color of his hair. In an age when technical education is so easily obtained such knowledge alone cannot win large rewards. It is very easy to get men who can solve problems in mathematics and mechanics given the necessary data; but it is very difficult to get men who can assemble the data in proper form from the work in hand. It is easy to get men who can use steam tables and indicator diagrams in the solution of a power problem, but it is very difficult to get men who can see this power problem in the plant conditions.

It is also easy to get men who can sit at a desk and solve complicated problems in applied mechanics, but it is difficult to get men who can go into the works or through the offices and solve the constantly recurring problems in applied human nature. As engineers we have been taught that our profession is for the purpose of subduing the forces of nature to the service of mankind, but we have not been taught, to any considerable extent, that human nature is one of the forces to be subdued.

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Every draftsman should realize the importance of specializing in one particular line of work. It is imposible for him to be a really good "all round" man;—like the members of other professions, he must choose the work for which he is best adapted and specialize in it.

REFRIGERATION DEPARTMENT

ECONOMICAL MANUFACTURE OF ICE.*

By B. King.

THERE are three things necesary to the economical manufacture of ice. The first of these is an ample supply of water; the second, an efficient boiler room; and third, an efficient crew. Some of you may wonder why I haven't extended this list to take in ice machines, brine tanks, storage rooms, etc., but I have omitted these for the reason that almost any of the standard types of ice plant machinery will give economical results if properly handled.

I am assuming that a plant has been installed in a guarantee which called for a certain number of tons of ice from a certain number tons of a particular grade of coal with certain specified water supply and temperature. If a plant is short of water, and by being short of water I mean having less than three gallons of water per ton of ice-making capacity with water at 60 degrees F., a few extra stands of ammonia condenser will pay for themselves in a short time. Under this condition it is also necessary to pay particular attention to having the condensers clean and to keeping plenty of ammonia in the system. As head pressure is likely to be high, it will also be very necessary to keep the system purged of permanent gas regularly, probably once every ten days. If the condensers are of the double pipe type, close attention should be paid to keeping the pipe scraped out. I have known plants to run with 5 pounds head pressure more than necessary simply because they didn't realize that the condenser will get dirty much more quickly when the supply of water is short, on account of the fact that the water will be more likely to deposit any solids it may contain, owing to the higher temperature resulting from such shortage of water.

Water Supply.

The owner of any plant that is short of water should find out first what it will cost him for enough additional water to give him four or five gallons per ton. Then he should figure the cost of installing a cooling tower; the cost of power for operating it; and the cost of additional ammonia condenser usually necessary with a cooling tower. By comparing these figures he can usually arrive at a definite conclusion as to whether it is best to spend his money for additional water, or spend it for additional cooling apparatus. Of course this does not apply to plants that have plenty of water, or to plants that have a limited water supply with no means of increasing it. It does apply, however, to a man who buys his water and to the man who gets water from artesian wells. If he can buy water as cheaply as he can build and operate a cooling tower, after allowing from 10 to 20 per cent. per annum for depreciation, he will be saving something on labor and will be better without the tower.

Artesian wells usually supply a great deal more water the first year or so that they are operated than afterwards. And for this reason you find a great many ice plants, after they have run four or five years, fighting the water proposition. Their business is probably increasing, and they are trying to get over capacity out of the plant with decreasing water supply. The result is that head pressure gets high, ammonia leaks become common, and the ammonia bill and coal bill become enormous. The only thing to do with a plant of this kind is to either sink more wells or put in a cooling tower. In fact, I believe it will pay in every case to keep the discharge pressure down to 175 or 180. Of course in the tropics this may be impossible.

The Boiler Room.

Turning to the boiler room we come to the source either of greatest economy or greatest expense, depending entirely on the method of operating; and it is here that the man who manufactures ice has to get efficiency. There is only one way to find out whether your boilers are doing what they should, and that is by measuring the feed water and weighing the coal. Almost any of the many valuable books on the subject of ice making will give you detailed instructions as to how to conduct a boiler trial more or less elaborately. For my part I do not generally go as deeply as some into the details connected with a boiler trial. In fact, for practical purposes it is only necessary to know the cost of the coal per ton; the number of pounds of coal burned in a given time, and the number of pounds of water evaporated in that given time. From these three you can easily arrive at the cost of evaporation of 1,000 pounds of water.

I might here quote a short rule for finding the cost of evaporation. This rule is one of the 100 submitted by the National Educational Committee or the N. A. S. E. during 1910, and is as follows: "The cost of evaporating 1,000 pounds of water is found by dividing the cost of coal per ton in cents, by twice the evaporation." With your data it is very easy to find the best kind of coal to burn for your plant, or to find the best method of firing a particular coal and the data also give you information that will enable you to see how many tons of ice you will manufacture per ton of coal. And by going a little deeper and arriving at a heat balance you can tell very easily if any part of the plant is not giving the results it should. I can probably better explain the meaning of a heat balance by illustrating. Let us take, for instance, a southern Illinois screening which has 12,000 B. T. U. Let us assume a boiler efficiency of 70 per cent.; this leaves us available in steam 7,840 B. T. U. per pound coal burned. Most ice plants are operated with a steam pressure of somewhere between 100 to 150 pounds. Let us assume a steam pressure of 120 pounds, and, with this coal, an evaporation of six pounds of steam per pound of coal. Now let us assume that the plant has a capacity of 100 tons of ice for 24 hours.

Steam Consumption.

With a moderate head pressure and a Corliss engine this size machine should not require more than two h.p. per ton capacity which will give us 200 indicated h.p. If the engine uses 25 pounds of steam per h.p. hour, the engine will use 120,000 pounds of steam per day; then we have had to burn 9.9 tons of coal to supply the engine. The auxiliaries should not use more than 300 pounds of steam per ton for 24 hours, which will make a steam consumption for the auxiliaries of 30,000 pounds and

*Abstract of paper read before the Illinois Ice Dealers' Association, Chicago, March, 1912.

will require 2.47 ton of coal. The waste from the reboiler and skim tank will vary considerably, depending entirely on plant conditions and the kind of water used. To be on the safe side, let us assume that we allow 250 pounds of water lost per ton in 24 hours. This makes an additional steam consumption of two tons. In some instances this may be somewhat less, but the figures given are very good practice. Now then, to sum up, we have 60 tons of water from the engine and 15 tons from the auxiliaries which makes 75 tons, but we have lost by evaporation from the reboiler and by skimming 12½ tons, which leaves us with only 73½ tons of water. The balance has to be made up, and this 26½ tons of water will require 4.41 tons of coal or a total coal consumption of approximately 18 tons.

Now if the plant is in the good condition that the above figures would indicate, we have two ways of making a considerable saving in getting this make-up water. One of these is by the "effect" system, which will evaporate probably 35 pounds of steam per pound of coal and would save from $6.00 to $8.00 per day in coal cost. The plant I am operating makes this saving by selling electric power and pumping water for the city and railroad shops. In fact, this is one of the things that makes this particular plant efficient. Even with the large auxiliary load from the light engines and water pumps, we are still short of water and sometimes have to make up with live steam from the boilers. I tried to get around the live steam proposition by carrying water high in the boilers and running the steam pressure down, but found that solids were carried over with the steam and I couldn't get clean ice without putting in extra filtering apparatus, so I had to go back to the live steam make-up. Any plant that is not compelled to get make-up water from some source is not as efficient as it should be, and with the high cost of labor and fuel no one can possibly afford to operate a plant under these conditions.

Deterioration of Plant.

The deterioration of an ice plant is generally rapid, due to the fact that the machinery sees hard service for about eight months of the year and in a great many cases the operating force is cut down to such an extent the other four months that the proper amount of work is not taken care of from year to year. There isn't any too much profit in manufacturing ice even with the machinery in first-class condition, and none at all if the machinery is allowed to run down.

This brings us to the third economy, that of an efficient crew. It is here that the dividends are made or not made, as the case may be. Because it is impossible to get efficiency either in the engine room or boiler room with a crew that is inefficient. It is here that engineer in charge has to forget some of his engineering and absorb a little good sound business judgment. One of the things that is holding many a good man back to-day is the fact that he spends too much time figuring how he could make an ice machine so much better than the one he is operating; or a pump that would work so much better if a certain change were made in it; or a boiler that would evaporate so much more water than the one he has. And when you go into the plant you will find that while he is busy figuring on how he would build a new plant, the man who is pulling ice has made up his mind that he wants to get home one hour earlier and has several rows of empty cans on the tank, in place of pulling slower and keeping the can filled, as pulled; or else the oil has become stopped on some of the bearings due to the fact that the oiler has become interested in something foreign to his work; or else the fireman has neglected cleaning fires until the steam starts to go down, and the result is a reduction in the amount of ice manufactured, but no corresponding reduction in the pay roll or in the coal bill.

I do not believe in the man in charge driving the man under him, but he must remember that he can't be a good fellow without the other fellow taking advantage of it at times; and for you to be a good fellow costs the company money. The men who are under you will respect you more if you insist on a day's work for a day's pay, and if you have to watch an engineer, a fireman, an oiler, or any other employe who does not take a live interest in the plant and who has not a well developed sense of responsibility, you had better get rid of him and get some one that has. In the first place, pay him wages that he cannot readily get anywhere else and then make him earn it. The hardest fight I have had in operating has been along this line. It takes a lot of patience and a lot of hard work to get a power plant force built up to an efficiency that will result in a reduction of the repair bills without allowing the plant to go without necessary repairs; and you cannot get this efficiency if the men do not know that back of it all they will get a square deal. I make it a point to hire young men and to spend considerable time teaching the principles underlying the whole process of ice manufacture from the boiler room to loading the ice on the car. I also make it a point to keep in touch with the other smaller plants in that part of the country, and when there is an opening that would be an advancement for a man that has worked hard for me I do everything I can to land him in position and help him to make good afterwards. By practising this method I find that the men under me work with a will and a vim, and take a much greater interest in the plant. In fact, the result of this square dealing and boosting has resulted in a plant loyalty that is bousd to make success.

SOME ASPECTS OF DIESEL ENGINE DESIGN.

At a meeting of the Institution of Engineers and Shipbuilders in Scotland at Glasgow, Mr. David M. Shannon read a very interesting paper on Diesel engine design. He said that this prime mover promises to work greater changes for the benefit of man than those which the steam turbine has wrought. The pity is that the changes now going on are chiefly of Continental origin.

In passing, it might be well to warn those about to take up the manufacture of the Diesel engine that nothing but the best materials and workmanship will suffice. Otherwise there is the danger of doing a promising motor great harm in its infancy. These are points that are usually brought home very severely to steam engineers on first taking up the oil engine. The reason for greater accuracy and better material is, of course, due in the first instance to the high pressures that have to be dealt with, and secondly to the small volume occupied by the power medium. In an oil engine one cubic inch of oil for power purposes is, on an average, equivalent to 5500 cubic inches of steam used in a steam engine. Hence, the measuring and burning arrangements must be made with great accuracy, any slight variations from which might mean large variations in power and efficiency of the machine. Experience has shown that only a few thousandths of an inch here and there make the difference between a good running motor and complete failure.

The oil engine, it should be remembered, is still in its infancy, and the greatest care is required in its design and manufacture. Oil engine workers recognize that the piston engine is only a temporary solution to the problem, and that a reversion to the turbine principle will be the natural outcome of the inherent limitations and disadvantages of the reciprocating form of motor.

Great efforts are being made with engines of the turbine form, and only those engaged in the industry know how enormous are the difficulties to be over-

come. It is interesting to note that the only reason why oil engines have been practicable for so many years is the fact that, the surfaces coming into contact with the flame receive a little rest between the explosions in which to dissipate the heat.

If the process be made continuous as in the turbine form of motor, then trouble from this source might be overcome by allowing one set of blades to cool down while another set carried on the work, or by trying a turbine of the bladeless form. Again, the steam turbine only shows superiority over the reciprocating engine when it is made condensing, and this advantage cannot be gained in the internal-combustion turbine over the reciprocating engine. There is also the difficulty of obtaining an efficient compressor of the turbine form, and it is not logical to carry out one part of the process with a piston machine and the other part with a turbine. This difficulty would be minimised with a producer which would produce gas at a pressure of, say 150 lbs. per square inch, or make a fixed gas from any class of cheap oil. Facts seem to point strongly against the success of the internal-combustion turbine working on any of the present cycles, and until a new cycle or a new heat carrier can be found, there is little hope of much progress being made in this direction.

Large Units.

A question that is greatly exercising the minds of engineers is: How big can the Diesel engine be made? Steam installations have already reached the enormous total of 90,000 h.p. concentrated in one ship, and at first sight this would seem quite hopeless to attempt with oil engines. Experiment and the present means of manufacture seem to be the determining factors, and it is probable that the size of the crankshaft and not the size of the cylinder will limit the power of the oil engine. Considering that 2,500 h.p. has been put into one cylinder, I have assumed for the sake of argument that it is possible to put 2000 h.p. into one single-acting two-cycle cylinder, or 4000 h.p. into one double-acting two-cycle one. Since the volume of the cylinder rises as the cube of the dimensions and the area of the exhaust ports is roughly proportional to the square of the dimensions, it follows that there is an economic limit to the size of the cylinder on account of the increasing length of the ports in proportion to the stroke of the pistons. This limit is certainly over the powers assumed. By combining twelve single-acting two-cycle cylinders, or six double-acting ones, then a total of 24,000 h.p. is reached for one shaft, and if three shafts are used this would amount to 72,000 b.h.p. in one ship. The pistons of this motor would be about 45 inches in diameter, and the stroke 60 inches. The crankshaft would be 27 inches in diameter, stressed to 11,000 lbs. per square inch. The two halves of the single-acting motor would be in separate engine-rooms. By using high-tensile steel and a judicious arrangement of cranks, it would be possible to increase the power up to 30,000 h.p. for the same diameter of shaft by adding two extra double-acting cylinders, thus giving 90,000 b.h.p. in one ship.

The diameter of shaft given is limited by bearing pressure considerations; and the power, as already suggested, that can be passed through it, can only be increased by using a better quality of steel, and increasing the number of cylinders in a line, instead of increasing the diameter and stroke of the pistons. The large diameter of shaft in proportion to the throw would necessitate the pins, webs, and shaft being forged solid, thereby increasing the difficulties of manufacture.

Some Disadvantages of the Type.

Some of the claims made on behalf of the Diesel engine are not quite accurate. The absence of ignition gear is not an advantage to the engine, but constitutes what is probably its greatest disadvantage. In place of simple electrical ignition gear, there is a very high pressure to deal with in the working cylinder, and a complicated two or three-stage compressor to provide injection air at a pressure of 800 or 900 lbs. per square inch. This demands the finest workmanship and the greatest care in handling, and has proved the only weak point in some jobs that have otherwise been faultless.

Because the charge is not admitted until the piston is near the top dead-centre, it is argued that it is impossible to obtain pre-ignitions. It is only necessary to have a leaky fuel-injection valve in order to obtain them, although in the Diesel engine they are not so violent as in engines working on the Otto cycle, for the reason that the pressures are much higher, and the changes in pressure are not, therefore, so noticeable. Further, the temperature to cause ignition is only reached when the piston is near the top dead-centre. The real danger is that the high pressure air would leak into the cylinder if the needle valve were to stick open, and the piston on rising would enormously increase the compression pressure. At least, to my knowledge, two engines have been completely wrecked by causes which could only be traced to this, and it is, therefore, imperative that Diesel engines of any size for marine purposes should be fitted with relief valves on all the cylinders. Again, there are no violent explosions in the Diesel engine when working, for although the changes in pressure are great they are gradual, and do not give rise to shocks, as is experienced in engines working on the Otto cycle.

Absence of Trouble in Exhaust System.

One of the greatest advantages of the Diesel engine is, that however small the quantity of combustible matter injected into the cylinder may be, it is certain to burn. Hence no weak charges can be sent into the exhaust system to cause trouble. This fact makes the Diesel cycle eminently suitable for dealing with gaseous fuels especially for reversing engines, and I think that this is the correct line to work along in developing gas plants for ship propulsion. In a reversing engine working on the Otto cycle there are always one or two cylinders full of mixture, and at the point of reversal explosives are discharged into the exhaust. Then, again, it is wrong to introduce the fuel into the cylinder before the exhaust ports are closed, for no matter how great the precautions or attempts at stratification, it is quite impossible to prevent the escape of fuel during charging. At the finish of charging there is always some gas in the ports and clearances, and this is swept out through the exhaust during the next scavenging period. These things tend to make the efficiency of the large two-cycle gas engine rather poor, and any development must take place by withholding the gas until the exhaust ports are quite closed.

I am not aware if Diesel engines have been run with gas, but all that is necessary to test the idea is a pressure intensifier in conjunction with the existing multi-stage injection air compressor.

Cranks should be arranged with regard to the following points, which are given in order of importance:—

1. Uniform twisting moment.
2. Balance of the engine as a whole.
3. Unbalanced couple between any two or more adjacent cranks to be as small as possible.
4. The angle between two adjacent cranks to be as large as possible, so as not to have them both firing on the downstroke, and causing excessive pressure on the bearing between them. If there are two bearings between each crank this point has little significance.
5. If the shaft is made in pieces, these should be interchangeable, in order to keep down the number of spare parts.
6. In four-cycle work, adjacent cranks should not be arranged on the same centre line, on account of concentrating the centrifugal and inertia loads.
7. As far as possible avoid making the maximum twisting and bending moments occur at the same instant.

Ease of Balancing.

It should be noted that balancing is a much easier problem than in steam work, on account of the greater number and flexibility of arrangement of cranks, and it is possible in nearly every case to obtain excellent balance without disturbing the equal phase differences of the working cranks, or adding balance weights to them.

In crankshaft design it is generally assumed that the maximum moments on the shaft occur when starting and before inertia has had time to come into play, and that this will be due to gas pressures caused by the working fluid. On account of the manner in which Diesel engines are started, however, this is certainly not the case. In a four-cylinder engine the starting air is admitted over a crank angle greater than 90 degrees, in order that the engine will start from any position, and in a six-cylinder engine the angle will be something more than 60 degrees. The pressure of the starting air is generally about 500 lbs. per square inch, and it can be shown that the stress due to admitting air over a crank angle of 90 degrees, as is done in six-cylinder engines, will stress an engine shaft to 14,000 lbs., that would otherwise be only stressed to 8000 lbs. per square inch. This is rather barbarous treatment of shafts, and it would be much better to relieve the compression pressure to 150 lbs. per square inch and use starting air through a reducing valve, at that pressure, at the same time effecting a large saving in compressed air. On starting, cards showing pressures of 700 lbs. per square inch have been taken from Diesel engines, this high pressure being due to the starting air pressure mounting up before the pistons had time to get under way.

The noise caused by some cam and roller gears is due principally to two causes, the first and greatest being the speed with which the cam strikes the roller, and the second the valve striking the seat. If the first can be eliminated, the second will naturally vanish, or at least cause no inconvenience, since it occurs inside the cylinder, and is consequently of a muffled nature. For noiseless running the flat part of the cam profile should slide under the roller at a tangent, and should grip the roller with no velocity. If this is done the valve can then be puhed open as rapidly as desired. The same remarks apply to the closing of the valve.

Applicability to Marine Work.

The following notes and suggestions on marine requirements may not be without interest. They refer principally to 2-cycle engines.

The use of the stepped piston engine is not advisable for marine work, chiefly on account of the amount of gear that has to be dismantled before a piston can be examined. In all designs this means the removal of a cylinder, and in some, the camshaft and gear extending over two cylinders, in addition. The advantages claimed for the design are that balancing is much easier and better, and that if the scavenging part for one cylinder breaks down it only affects the working of that cylinder. The latter reason is quite sound, but with regard to balancing, any addition of weight to the reciprocating masses is bad, and aggravates any unbalanced forces and couples there may be in the engine. In some engines, such as the four-cylinder type with cranks at 90 degrees, it is desirable to have an additional crank, since this can be arranged to give a good balance without disturbing the equal phase difference of the working cranks. It also makes a cheaper engine to have a separate scavenging crank, although the cylinders do not all receive the same measured quantity of air.

Some of the stepped piston engines have only one fuel oil pump for supplying all the cylinders, and if it breaks down or gets choked up, which is by no means uncommon, the whole engine stops working. The better method is to have a separate pump for each cylinder, so designed that it can be overhauled without stopping the engine. Higher powers have been obtained from engines so arranged, because the supply of oil to the cylinders is better under control. This design possesses advantages from the standpoint of governing which is a most important feature in marine engines. In a six-cylinder engine with one oil pump, one stroke of the pump delivers six charges of oil. Now, supposing that the governor was required to act immediately after the pump had made a delivery, it cannot affect the six charges which have gone beyond its control, and must go through the cylinders, even although the propeller may be out of the water. With six separate oil pumps delivering at intervals to suit the crank arrangement, it would have been able to act upon five of the charges, and would, consequently, be much more sensitive in its action. The oil should be withheld from the Diesel valve until it is just about to open, so that the governor has a chance to act upon it right up to the point at which it is required in the cylinder. With oil engines there is not the slightest fear of racing taking place on account of the propeller lifting out of the water, for it is possible to throw the whole load instantly off the engine, and there is no perceptible variation in speed. The usual method of starting up these engines is to admit air to all the working cylinders, and when a certain speed has been reached, to cut the air off from half the number, and turn the oil on. When this half has commenced firing, the air is shut off from the other cylinders and oil turned on, when the whole engine will be running on oil. Instead of this method all the pumps may be dropped into gear at the same instant that the starting air is turned on, and as soon as firing has commenced the starting air should be shut off all the cylinders. By this method, as soon as the engine begins to move, the oil pumps begin delivering, which results in quicker starting, and effects a saving in starting air.

If the ship is fitted with an auxiliary set of engines, provision should be made for sending the hot water discharged from it through the cylinders of the main engine. This preliminary warming up would prevent the engine being subjected to sudden variation in temperature.

In twin-screw vessels, the gear on each cylinder need not be handed, because each cylinder is a complete unit, and there are no great structural changes such as exist in steam jobs. It is rather a convenience for a man to turn from one engine to the other and find it exactly the same. It also means less first cost, and only half the number of spare parts are necessary.

In order to increase the power for purposes of overload, or in cases of emergency, it is only necessary to create a denser atmosphere in the engine-room, by the usual forced-draught appliances, the engines having first been designed to suit the increased compression pressure. With four-cycle engines this is all that is required, but with two-cycle engines the case is different, on account of the cylinders being open to the outside atmosphere during charging. The back pressure in the exhaust would require to be increased, which can be done by means of a water seal, an arrangement that permits any desired back pressure to be used. If scavenging pumps are separately driven it is not necessary to increase the atmospheric pressure in the engine-room. The speed of the pumps would be increased instead, thereby increasing the scavenging air pressure, and at the same time the back pressure on the engine would be artificially increased.

The man who rises is he who has the courage in a crisis to act promptly on his own initiative. Some men always wish to have the advice of half a dozen colleagues, no more competent than themselves, before they dare reach a decision.

THE READERS' POINT OF VIEW

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

OIL IN STEAM LINES.

J. E. Noble.

THE article, "Oil in Steam Lines," page 178, June issue, The Power House interests me. The author mentions dogging of traps with oil, but what about the boilers that receive returns into which a quart of oil has been placed each day. No doubt a small quantity of oil will adhere to the sides of the pipes, but some highly efficient method must be planned to remove the unused oil from the condensation before it is returned to the boilers, otherwise a burned boiler will be a quite possible and ever probable result.

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F. N. writes from Port Arthur as follows:—Thought I would drop you a line to let you know that Branch 29, C.A. S.E., of Port Arthur, is still in the ring. At a recent meeting of the branch, Bro. John Insley in the chair, the principal discussion of the evening had reference to the number of steam plants that are in active operation in this district in charge of unlicensed attendants. There are quite a number of plants round here where the engineer goes off duty at 6 p.m., after which hour everything is left in the hands of men who do not carry a certificate. When Bro. McGhie comes this way we shall try to get these matters adjusted.

Our lodge has now been in existence one year, and in that time we have about doubled our membership. With a new set of officers, we are looking forward to a much larger increase in the coming year.

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VERTICAL ENCLOSED ENGINES.

By R. E. C.

VERTICAL engines are particularly adapted to all kinds of mill, factory and electric power plants where floor space is valuable or where a high-grade, durable engine is needed for hard, continuous service. They are made in single and double-cylinder high-pressure, two or three cylinder compound, and triple-expansion arrangements. The high rotating speeds and pistons of large diameter compared to length of stroke produce a powerful engine in a relatively small space. They will run quietly and satisfactorily at piston speeds of 500 to 800 feet per minute and it naturally follows that when these engines are direct-connected to electric generators, the latter also, can be of small diameter, which results in a combined unit of relatively low cost for a given kilowatt output.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

Among the features which contribute to long periods of operation with little or no attention may be mentioned:—

First—Positive lubrication of all bearings, with an oil pressure of about 15 pounds per square inch.

Second—Complete enclosure of all moving parts which prevents oil flying about.

Third—Almost perfect balancing of reciprocating parts by means of proper steam distribution and accurate counterweighing.

Fourth—Noiseless operation due to the positive lubrication and correct balancing.

Fifth—Low steam consumption which follows a design with very small clearances, high rotative speed, and refinement in finish.

The complete enclosure of these engines with their noiseless operation is of particular advantage in office buildings, hotels, and other places in a large city where the noise of ordinary machinery will not be tolerated. The long, hard service required in electrical plants requires that the metals in bearings be prevented from coming together in order to avoid wear. The forced lubrication under pressure provides a thin film of oil between such surfaces, and this condition, combined with proper adjustment, makes it possible to run these engines a long time without attention. Numerous cases of actual installation are on record, in which these engines have been operated for two years continuously without adjustment. After this period of continuous service, an examination of the parts showed the wear to be measured only in thousandths of an inch.

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PRESENT STATUS OF HYPOCHLORITE TREATMENT OF WATERS.

The sterilization of water by the use of hypochlorite of calcium or sodium has become an approved process and is on similar footing with filtration as a means of protection against water-borne diseases. The word sterilization alone is an index to the rapid advance that water purification has made in the last few years. It is quite remarkable when one considers that only a few years ago filtration was in its infancy and now people are demanding sterilization. In 1890 only 200,000 people in the United States were supplied with filtered water. At the present time 22 per cent. of the urban population are using filtered water.

The treatment of water with hypochlorite to destroy objectionable bacteria was mentioned some twenty years

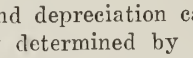
ago, but practically all work was scattered and desultory in this country until 1908. During that year some spectacular results were brought forth from the Chicago stock yards. Following this the Boonton, N. J., plant was installed by Messrs. Herring and Fuller, George A. Johnson being in charge of the plant. Since then many cities have adopted this plan of purification, either as the only treatment of the water or as an adjunct to some process already in use. The remarkable success reported has led some to recommend hypochlorite as a cure-all for water troubles . However, there are limitations as well as advantages to the process which will be brought out later.

The chemistry of the action of bleaching powder in water is relatively simple. Bleaching powder is a mixture of almost equal parts of chloride of lime and hypochlorite of lime. This combination is acted upon by the water and readily forms a solution of calcium chloride and calcium hypochlorite. When hypochlorite of calcium is added to any natural water the free or half bound carbonic acid in the water reacts with it and there is formed calcium carbonate and hypochlorus acid. This hypochlorus acid is a very powerful oxidizing agent and upon this peculiar property depends it virtue as a germ destroyer. It is found by experiment that with water free from large amounts of organic matter and iron, .2 of one part per million of available chlorine is sufficient to destroy oll organisms that are not spore formers. As the organic matter increases, larger amounts of hypochlorites are necessary to destroy the organisms.

In speaking of bleaching powder one usually expresses the strength in amounts of available chlorine. However, it is the oxygen and not the chlorine that does the work. The Hon. Wm. J. Magee, master of the New Jersey Court of Chancery, rendered his decision upon the results of the plants at Boonton, N. J., stating that in his opinion the sterilization system "is capable of rendering the water delivered to Jersey City pure and wholesome for the purpose for which it is intended and is effective in removing from water those dangerous germs, stated by the decree to possibly exist there at certain times." This decision, together with a mass of data which has since been brought forth, is of vast importance to every sanitary and water engineer, for undoubtedly the applications and uses of hypochlorite will be extended so as to practically revolutionize the treatment of water, but it must be borne in mind that this process has the same great drawback common to all others: The personal equation of the operator. If anything, this process requires more attention than others.—Ex.

RAILWAY TRACTION AND THE EXPLOSION ENGINE.

THE arrival of the internal combustion engine in its present compact and highly efficient form has added a fresh alternative to the possible solutions of the problem of railway transport. Motor omnibuses running on the highways have taken from the railways a great deal of suburban traffic, and the effort made by the railway managements to recover the lost ground has so far been in the direction of electrification. The adoption of electric operation has been materially hindered by two distinct causes, one the great cost of conversion, and the other the difficulty of choice between the direct and alternating-current systems. It is to be feared that even additional delay may result from the entry into the field of competition of the explosion engine. This newest rival may be regarded as comparatively untried for this work, but it presents the attraction that if it should prove suitable it would have nearly all the good features of the electric system without its drawbacks. It would avoid the costly overhead, or underneath, construction required to convey the electric energy, and the expensive generating station, sub-stations, cables, etc. But it would doubtless prove to have disadvantages of its own even in these directions. The cost of equipment might prove more expensive than promoters expect, and the cost of renewals and repairs might conceivably more than balance any gain on capital charges. Only experience can determine this, and although some data is available for estimation, there is nothing approaching the abundant material on record in the case of steam and electric traction. Nevertheless experience of running petrol-electric cars on the Hungarian railways seems to show that the total costs per mile are only about half those of steam motor coaches. At the meeting in July, 1910, of the International Railway Congress, Mr. C. P. Clark, the reporter for the United States on this question, advised caution, and remarked: "The question of first expense, cost of repairs, and depreciation cannot be satisfactorily determined by the performance of isolated cars under different weather and topographical conditions where the prices for the same kind of fuel and service vary greatly." For these reasons it is best to regard the question as an open one. The reason why power costs in electric schemes are able to compete with similar figures for steam traction in spite of transmission losses is that the steam engine is much more economical of fuel in large sizes than in small, and that the highly efficient condensing turbine cannot be applied to a locomotive. With the internal combustion engine it is different; the engine is as economical in 10 horse-power units as it is in 1,000 horse-power units, and the form of engine, which is, of course, reciprocating and non-condensing, is as suitable for locomotive use as for a central station. The limit of size operates indeed in the reverse way from that in a steam engine. In an explosion engine it is impracticable to make the cylinder of more than a certain diameter, and there is every reason to put in small units rather than large ones. For this reason it is not likely that internal combustion engine locomotives comparable in size with steam locomotives will be as useful as motor coaches, with or without one or more trailer cars. The smallness of the unit tends also to diminish the weight per horse-power. Experience with racing motor cars has enabled designers to produce petrol engines which will run with silence and ease at very high speeds, thus producing great power from small size. Units of perhaps 200 horse-power are about the size which at the moment are likely to be most useful for railway work. Considerable numbers of gasoline motor coaches are now running in America, and about as many on the Continent; there are also a few here. Many of the American cars are designed on motor car lines with clutch transmission and a gear box for starting and hill climbing. It is questionable, however, whether these devices, easily as they can be employed for road conditions, are really as suitable for the harder conditions of railway work as some partially or wholly electric or hydraulic system. It must be remembered that the weight, and therefore the momentum, help out the motor when accelerating or hill climbing, and that when running at other times the drive is direct and no current passes. This removes the main objection to the system, and there remains only the weight of the extra gear, which is certainly a disadvantage, although it need not perhaps be so great as materially to damage the success of such schemes. —The Engineer.



"It is very true that the engineering profession is one of practical work, but no one can hope to achieve prominence in this profession who cannot write good, understandable English. An engineer may not talk, but he must make reports, he must write letters, he must draw up specifications, make plans. To do these things properly he must command, and know how to use, the tools of language." Saunders.

SAFE OPERATION OF JET CONDENSERS.

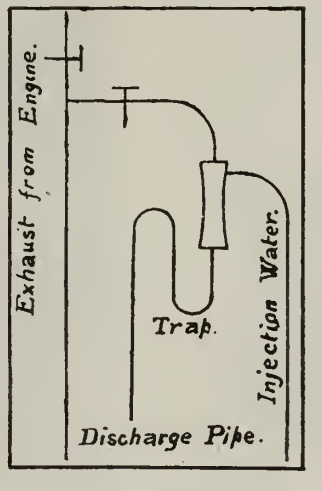
THE primary object of installing a condensing plant in a steam power-house is to make the engine a more efficient motor thermally. To accomplish this desirable end, the condenser and its auxiliaries must not only be well and efficiently designed and installed, but they must also be intelligently operated. The factors which govern the choice between a jet condenser and a surface condenser are many and must be considered with special reference to each particular case. It may be broadly stated, however, that the jet condenser is 50 to 60 per cent. cheaper than the surface condenser in prime cost, that it requires less operating attention, repairs and maintenance, that less water is necessary for the maintenance of the vacuum, but that the air pump must have a considerably larger capacity than that fitted to a surface condensing plant, which involves more power for driving this auxiliary. On the other hand, the degree of safety which accrues to the surface condenser is much greater than that which can be attributed to the use of the jet type. Numerous accidents have been caused in the past, and many more will be caused in the future, by ignorance of erecting and operating engineers concerning the principles underlying the operation of jet condensers. It is the writer's object to set out in this article come of the causes of destructive jet condenser accidents together with some of their remedies and preventatives.

Starting-up and Shutting-Down.

The majority of accidents with jet condensers occur when the engine attendant is just getting his engine up to speed, or else when he is throttling down to stop. The usual result orvisual effect of the accident is a broken cylinder head with or without the accompaniment of a buckled piston-rod., a bent crank, a cracked pillow block or a sheared fly-wheel key. The agent producing this effect is water in the cylinder. When starting up an engine equipped with a jet condenser, if the condensing water is supplied under a head, first turn this on, and when a vacuum is formed, gradually open up the throttle and get the engine up to speed. If the condensing water has to be lifted, the first thing to do is to open the steam pressure jet valve, and as soon as this has lifted the water, the engine can be started. In both cases the operation of condensing will commence as soon as the engine exhaust reaches the condenser, when a vacuum will be formed; in the case of the water being lifted, the lifting jet may now be shut off. In shutting down the engine, first stop the engine itself; then, if the injection water is under a suction lift, the operation of condensing will cease automatically. If the water is under a head, first stop the engine and then close the valve controlling the water supply.

Injection Water Supply.

The supply of injection water should preferably be under a suction lift, not a head, on the score of greater safety. It is dangerous to have the water under a head unless some extremely reliable automatic cut-off for the flow is provided in case the vacuum should fail whilst the engine is running. Under such circumstances the head pressure would tend to cause the water to back up through the condenser into the low-pressure cylinder. A trap which will prevent water from getting into the steam line is to be found in quite a number of steam plants in the United States, and is simply constructed, as shown by the piping diagram below. In this the trap is indicated by the U-bend, of which it consists. It is connected to the bottom of the condenser and creates a vacuum in the exhaust steam and water supply pipes, syphoning the air out of the condenser and preventing water from getting into the engine exhaust pipe.



Discharge Pipe Location.

A question which is often asked—and therefore presumably not very generally understood—is, "Why must the discharge pipe of a jet condenser be under water?" With a free discharge there is no danger whilst the condensing water is turned on and the injector has a correct elevation. If, however, the injection is cut off and the throttle closed at about the same time, conditions are ripe for a costly smash. The tail pipe acts as an air lifter in such a case, thus flooding the cylinder with water. It may be worth while giving a little further consideration to this phase of the subject.

Suppose the tail pipe is not under water at its discharge; then if the throttle be shut and the injection water cut off, the water will run out of the tail pipe until it is balanced by the atmospheric pressure. If, then, the vacuum on the engine side of the condenser should improve, owing to the low-pressure piston and cylinder acting as a vacuum pump, the atmospheric pressure will lift the water remaining in the tail pipe over into the engine and will probably succeed in wrecking it. Where the tail pipe is covered at its discharge with enough water to maintain a full column, there is no danger; but if the external water level is insufficient to preserve this column, there is always present the danger that the atmospheric pressure will predominate by a degree sufficient to enable it to lift the water over. In this connection the writer had a case brought to his notice in which the water in the hot-well was too shallow to keep a sufficient height of water in the tail pipe, with the result that over $750 worth of damage was done to the engine.

Air Pump Drive Consideration.

Compound condensing engines equipped with self-driven air pumps present rather a special case. If the engine be started up slowly, the vacuum extends back as far as the receiver, since the friction load only involves a short steam valve opening on the high-pressure side. If, then, the injection water to the condenser be more-than "cracked," it will back-up through the condenser into the low-pressure side of the engine, in which case the air pump, being driven by the engine, will not have attained enough speed to remove the water as fast as it accumulates in the condenser. These facts must be borne in mind when operating a syphon condenser with an engine-driven air pump.—From paper by John S. Leese in "Practical Engineer."

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MOTOR TRUCKS REPLACE HORSES.

WHAT seems to be the proper breadth of view regarding the superiority of motor delivery over horses is taken by A. E. Holmes, of Chicago, superintendent of a large retail furniture house. Mr. Holmes' concern replaced fifty horses with five Kissel Kar three-ton trucks, which have rendered a much cheaper as well as better service. Mr. Holmes thus expresses himself. "In our business we must be up-to-date. Our customers demand the best we can give them in service as well as in goods. Even if motor trucks were more expensive—which they are not—we would never go back to horses."

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The reason that manganese bronze castings leak under pressure is because of the aluminum in them. They cannot, however, be made without the aluminum.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

DIRECT-CURRENT TURBO GENERATORS.

DIRECT-current turbo generator units find wide application where a simple, compact, reliable generating set is desired. They are used for exciter sets in alternating current generating stations, for lighting and power in industrial plants, office and apartment buildings, for storage battery charging in railway signal work and for train lighting. They are particularly applicable for exciter service in modern generating stations where the steam pressure exceeds 125 lbs. per square inch, because small reciprocating engines ordinarily used for driving exciters are usually designed for pressures not greater than this. Where the boiler pressure exceeds 125 lbs. per square inch, a reducing valve must be used with such engines. The type of turbine here illustrated, operates directly on pressures up to 200 lb., and with steam superheated 150 degrees Fahrenheit. As compared with reciprocating engine sets, the features in favor of the turbo-generator are:—

Simplicity — Reliability—There are few moving parts, such as rods, levers, eccentrics, and cranks; few parts that require attention because of wear; few bearings to oil and no stuffing boxes to pack; no reciprocating parts to wear out and no steam cylinders to be oiled. There is no oil in the exhaust.

Compactness—A reciprocating engine set occupies from one-half again to several times as much (depending on the speed and other characteristics) space as does a turbo-generator set.

Lower Cost of Installation—The first cost and the installation cost are also less, expensive foundations not being required for a turbo-generator unit.

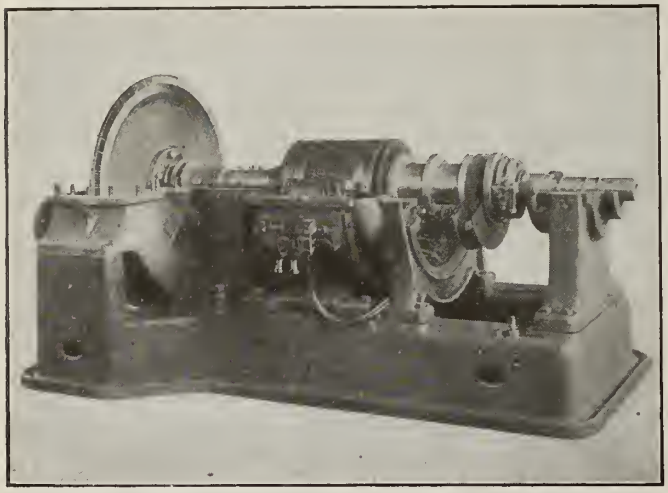


Fig. 1—Westinghouse 100 k.w., direct current turbo generator set with top casing removed, exposing runner and armature.

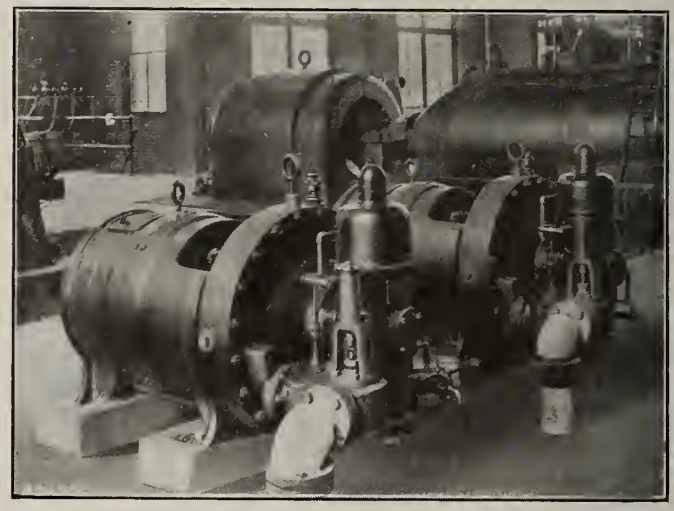


Fig. 6—Two 25 k.w., 125 volt, 3,500 r.p.m. direct-current turbo generators.

Particulars of Machines.

These machines are made in sizes from 10 kw. to 200 kw. Standard voltages are 125 and 250. Three-wire generators —125 and 250 volts can be supplied. The steam pressure range is from 75 to 200

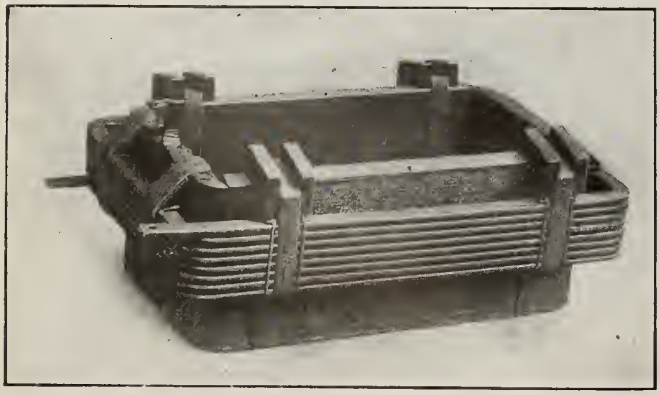


Fig. 2—Main coil-shunt and series windings.

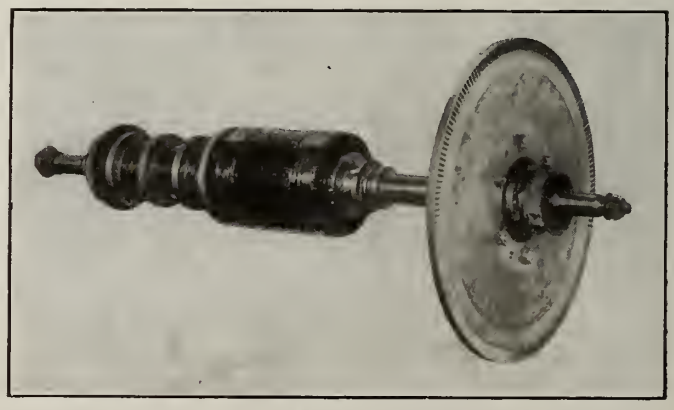


Fig. 4—Complete rotor for 100 k.w. unit, steam and electric end.

lbs. per square inch. Either shunt or compound wound generators are furnished. Standard compounding is 118 volts no load, and 125 volts full load, or 235 no load and 250 full load. Compounding can be varied by adjusting the shunt.

The turbine, fig. 1, is of the single wheel impulse type. The wheel or rotor is mounted directly on the end of the generator shaft. Although only one impulse wheel is fitted, an unusually high efficiency is obtained by using the steam two or more times on the one wheel. The governor is of the fly-ball type, and the weights are hung on hardened steel knife edges, minimizing friction. In case of overspeeding, the automatic safety-stop throttle valve is tripped, shutting off the steam supply.

The generators are of the commutating type which insures sparkless commutation with a fixed brush position at all loads within the capacities of the machines. The frames are of cast iron, and bolts hold the pole pieces to these. All frames are divided horizontally. The main poles, fig. 2, are built up of soft sheet steel punchings. The use of bolted-on poles permits of uniform pole spacing and, in addition, renders possible the removal of any individual pole. Commutating poles, fig. 3, are of steel and are secured to the frame with bolts. Main field coils may be either shunt or compound wound. Shunt coils are wound on forms and provide a large radiating surface. Series coils are wound of bare copper bar. The best possible heat radiation is assured.

The commutating pole coils are wound of bare copper bar held in position with insulated bolts. Ample ventilation is provided. Brushholders are mounted on rigid arms, and the brush tension can readily be adjusted to keep it uniform as the brush wears away. Armature are of the drum type, and armature coils are form wound, interchangeable, and thoroughly insulated. The spaces between the coils at the ends of the armature are packed with insulating material to prevent the entrance of dirt. The commutators, fig. 4, consists of hard drawn copper bars insulated with mica, and steel rings shrunk around the bars, but insulated therefrom, prevent distortion by centrifugal stresses.

A complete oiling system is provided with each turbine. In the smaller sizes the well known ring oiling scheme is employed, while in the larger turbines, the oil is circulated through a closed system by means of a rotary pump driven from the main shaft through positive gearing. All parts of the turbines are readily accessible for inspection or repair; the upper half of the cylinder or casing being removable, fig. 1, without interfering with the valve or governor mechanism, and, if necessary, the wheel or rotor may be entirely removed from the casing. Generally speaking, the steam consumption of turbines of small powers compares favorably with the performance of automatic high speed engines of similar capacity. The guarantees of steam consumption are based on an average of actual test results, plus a comfortable margin.

Interesting installations of these generating sets are shown in figs. 5 and 6. The unit in the San Francisco Young Men's Association building furnishes energy for power and lighting. The two 25 kw. sets shown in fig. 6 provide exeitation for large turbo alternators in the Douglaston Long Island Plant, and have proved exceedingly satisfactory in this service because of their reliability and the small amount of attention they require. We are indebted to the Westinghouse Electric and Mfg. Co., Pittsburg, Pa., for the data and illustrations of their type T. direct current Turbo Generators, which form the substance of this article.

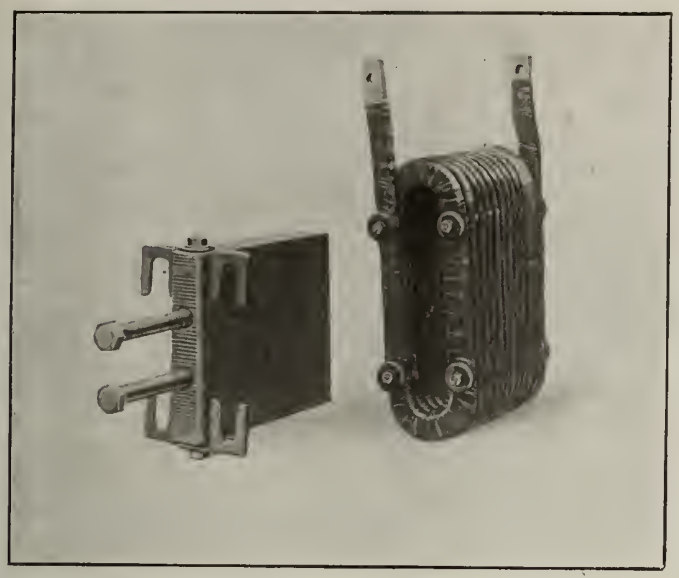


Fig. 3—Commutating pole and winding.

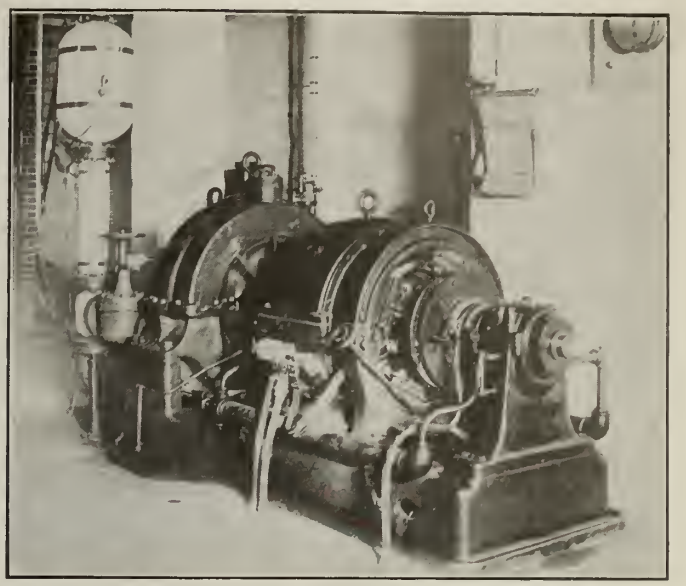
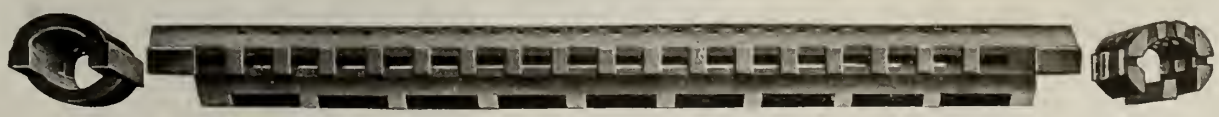


Fig. 5—100 k.w., 3-wire, 125-250 volt, 2,400 r.p.m. direct-current turbo generator.

THE THOMAS ELLIPTIC GRATE BAR.

IN the U. S. A. the elliptical grate bars herewith illustrated have been prime favorites since their introduction a few years ago, and a description of their leading features will doubtless prove of interest to all power users in Canada, since the bars are made in various styles to suit any type of boiler, including locomotive and marine. They are manufactured by the Thomas Grate Bar Co., Birmingham, Ala., whose Canadian representatives are the General Supply Co. of Canada, Ltd., Ottawa, Toronto and Winnipeg.

In addition to possessing all the advantages of other grate bars, the Thomas



THOMAS ELLIPTIC GRATE BAR. END VIEW, ELEVATION AND CROSS SECTION.

elliptic is made up of two oppositely curved surfaces joined together at each side with spacing and connecting lugs of one-third contact, leaving two-thirds air space. The top portion of the bar is the fuel-supporting part, while the bottom is the bar, or unit, supporting part. The heat from the top portion of the bar will attempt to equalize itself through these spacing and connecting lugs into the grate-bar unit, but on account of the excess air space around these spacing and connecting lugs a circulation of air from any and every direction radiates the heat from these lugs and it is drawn up into the furnace. Thus the lower or holding portion of the bar never gets hot, never crystallizes, cannot break, but retains its life and shape indefinitely, and holds the grate-bar unit in shape, preventing it from sagging, warping or twisting. Consequently the grate bar is only destroyed by actually wearing out, and so has a long life. With the lower portion never wearing, the grate--bar unit is held in shape even after the top or fuel supporting portion of the bar becomes crystallized and fire-cracked.

Another feature peculiar only to the Thomas elliptic bar is that it is a self-cleaning one while in operation, the curved surface of the bar enabling it to shed ashes automatically as they are made, which leaves live coal and fresh fuel on the bars at all times. The curved surface provides no flat place for ashes to lie on, bank up and foul over the draft spaces; on the contrary these draft spaces are always open and permit a free passage of air through the grates and through the fuel bed to combine with the gases. The cross rib type, which we illustrate, is made with ½-inch, ⅝-inch or ¾-inch bars, 2¼ inches deep, with air spaces ½-inch, ⅝-inch or ¾-inch wide between them, and is especially suitable for burning coal, wood or any coarse fuel.

The bars are made of a special formula of pig-iron, rendering them tough and strong, and enabling them to undergo long use and stand hard wear. Their elliptical shape of course gives them great strength and apparently they are giving users every satisfaction.

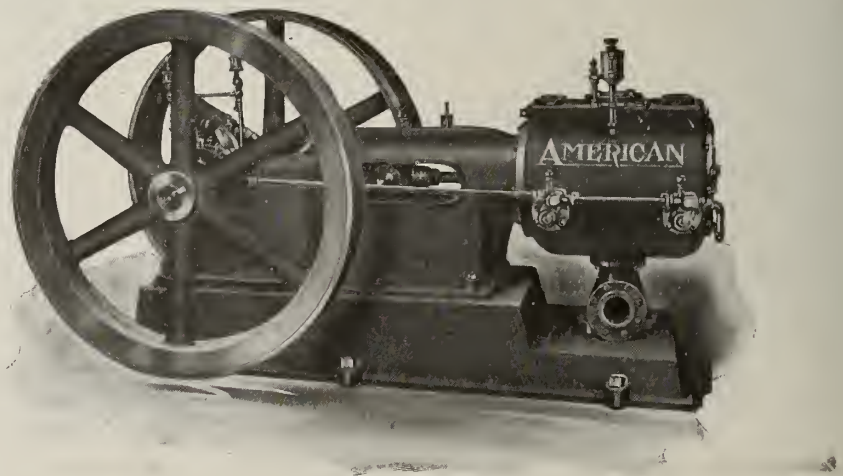
THOMAS ELLIPTIC GRATE BAR—PLAN VIEW.

CRANK AND FLYWHEEL AIR COMPRESSORS.

THE American Steam Pump Co., of Battle Creek, Mich., announce that they will shortly place on the market a new line of crank and fly wheel air compressors. These compressors will be built with the same high grade of material and workmanship which characterizes their extensive lines of Marsh and American pumping machinery and will represent the very latest and advanced ideas in air compressor design. As will be noted from the illustration, these compressors will be equipped with Corliss inlet valves, mechanically operated. These positively moved valves open and close without impact, therefore, are free from the hammering incident to poppet valves and insure a cylinder full of free air at each stroke of the piston even at moderate speed. The valves are so placed that they may be inspected by removing the plain bonnet without disturbing the valve gear. It is intended to build both steam and power driven types of these compressors in single and two stage patterns, with capacities ranging from 150 to 650 cubic feet of free air per minute.

IMPROVED TRAP SYSTEM.

AT the Saltpetre Works of Battelle & Renwick, Jersey City, N.J., a novel steam trap system has just been installed, which takes care of the condensation from the entire apparatus of the mill, and returns the same to the boilers. This system not only provides for all the condensation, but it is so arranged that the waste vapor from the vents of the traps is also condensed and returned with the condensate from other sources. The mill apparatus consists of nineteen special kettles for boiling. Each kettle is equipped with what is known as a pit coil, that is, the drip from the coil, instead of passing through the bottom of the kettle, is carried up over the edge, so that the water of condensation is raised six feet before it is discharged. Drying machines and a dry room are also included in the system. The approximate amount of steam required for boiling alone is about 600 h.p. The boiling point of some of the liquids in the kettles is as high as 270 deg. F.; therefore, live steam is required for this work. On account of the form of the coils, it has been found impossible to use ordinary traps on this work; each coil at the present time is equipped with a special No. 20 Lytton trap which discharges into one of the return mains, of which there are two, running through the factory and back to a receiving tank in the boiler room. The temperature of this return water varies from 260 degs. to 282 degs. F. The vapor from the special traps is used for drying purposes, and when condensed is returned to the boilers, so that no steam or vapor is allowed to escape into the atmosphere. On the boilers are located two 4-inch and one 1½-inch return traps, which take care of the return water from the factory at the temperatures mentioned and return it automatically to the boilers. The condensation from the live steam mains is trapped and collected in a separate return, which discharges into the receiver in the boiler room. By the installation of this system the saving in coal alone amounts to 2½ tons per day, while the boiling capacity of a number of the kettles is increased from 15 to 25 per cent. It has not only made a saving in coal and increased the capacity of the kettles, but it is feeding the boilers with about 90 per cent. of pure water, which prevents the formation of scale and also makes a reduction in the amount of make-up water purchased from the city.—Steam.



Crank and Flywheel Air Compressor.

Twin Strainer

Shut Downs are Expensive

The TWIN STRAINER protects your power plant against shut downs. It acts as guardian for your plant as it protects your pumps, boilers and condensers against damage from leaves, sticks and other floating matter in your water. We build them in all sizes to meet every condition. Our catalog is ready for you.

We have a full line of power plant accessories. A postal gets you a catalog on the Elliott-Pittsburgh Feed Water Heater, Filters and Grease Extractors, Exhaust Heads, Oil and Steam Separators, Steam Traps or anything we make.

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What a Liberty Cleaner has done

Nine years' accumulation of scale removed by a LIBERTY in 22 minutes. The boiler contained 144-4″ tubes 18′ long. The longest time required for cleaning one tube was 22 minutes.

The owners did not think they had enough scale to cause trouble, but consented to a trial. The result was a complete surprise to them. Have **you** any scale in your boilers? It may pay you to investigate.

Liberty Cleaners are always reliable, durable, economical and efficient. Made for every type of boiler and to meet all conditions and to be operated by air, steam or water as required. No scale so hard that a **Liberty** cannot remove it in record time. Write for catalog.

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POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

West Kootenay.—J. D. McDonald, general superintendent of the West Kootenay Power & Light compauy, states that in anticipation of the electrification of the Canadian Pacific railroad from Rossland to Castlegar next year the power plant will be much enlarged in regard to its power producing machinery.

Mr. McDonald said that the C.P.R. was contemplating the electrification of the whole line between Nelsou and the Bonndary of Nelson and Rossland in the near future and was preparing to transform the Rossland road in the coming year. lu order to meet this demand the power company will have to add at least 2,000 horsepower to the plant and is installing another unit of 6,600 borsepower to he added to the two already there. This will make a total productiou of current equal to 19,800 horsepower.

At the present time the Bonnington power plant is supplying the Boundary district with power, including Phoenix city, Granby and Rawhide mines, Grand Forks City, the Granby smelter and the farmers of tbe Kettle valley for irrigation purposes, the British Columbia Copper Company, Greenwood City, Mother Lode and the Jewel mines.

The company is also supplying all power to the Rossland and Trail district, including the Consolidated company's smelter and the Le Roi mine. It takes all the power supplied by the two 4,500-kilowat British Columhia electric generators to supply this demand, so that the electrification of the C.P.R. means greatly increasing the plant.

Mr. McDonald said that about 300 feet of wing dam would be huilt this fall, hut that as soon as possible the dam was to be built across the river, and then the whole water-power of Bonnington falls would be harnessed. Mr. McDonald also stated that the total potential prcduction of the falls equalled ahout 35,000 horsepower, the city of Nelson controlling 5,000 and the West Kootenay Power company the remainder, and that as soon as this proposed dam was built every available amouut of power would he used to meet the rapidly increasing demand and that hoth the old power plant, capahle of producing 5,000 horsepower as well as the plant at Cascade, with 3,000 horsepower, would he in use.

ALBERTA.

Medicine Hat.—The citizens on August 18 voted on a hy-law to expend $300,000 on the installation of a new waterworks plaut, the first unit of which will have sufficient capacity for a population of 7,500.

SASKATCHEWAN.

Regina.—Sealed Tenders addressed to the City Commissioners and marked "Tenders for Electrical Plant," will he received until noon on Saturday, the 14th day of Septemher, for the following:—

1—1,500 K.W. Steam Turhine Unit.

1—Switchhoard Panel.

1—Surface Condenser for Turbine.

1—25 K.W. Motor-driven Exciter.

Specifications may he obtained on application to the office of the City Electrician. A certified check for 5 per cent. of the amouut of the tender must accompany each hid. The Commissioners reserve the right to reject any or all tenders. A. W. POOL, City Clerk.

Watrous.—The preliminary work in connection with the development of an adequate water works system for Watrous has reached a well advanced stage. Something like $125,000 is now being spent on the development of the water and sewage system by the city council. Meanwhile work is going forward rapidly on the first unit of the hig new establishment of the Dominion Sanitarium, Limited, on the shore of Lake Manitou. Plans for other important huildings, including many residences in and about Watrous, are said to be on the hooks of the coutractors for early completion, while a great deal of real estate especially huilding sites and residence property, is now heing traded in hoth in Watrous proper and at Crystal Spriugs along the south shore of the lake.

MANITOBA.

Norwood, Man.—The Consumers Ice Company has heen organized with the intention of erecting a plant in this place. Many Winnipeg men are interested in the project. Among the list the following names appear: W. S. Thomson, president of the Algoma Steel Bridge Company, president; A. J. Andrews, vice-president; F. E. Cryder, managing director; J. R. Forman, secretary-treasurer; Dr. E. A. Jones. The product of the works will be clear, pnre, hygienic ice from natural artesian water under the Harrison process which is in use in Chicago, Detroit, Columbus, Indianapolis, Minneapolis and many other large cities in the United States. The Norwood plant will he the first in Canada. The contract will be let immediately for the buildings, which will include the following: Main building, 90 x 231; two other buildings, 50 x 97 feet each; garage, 60 x 85. The company's delivery will be made eutirely by auto, truck, and about thirty machiues will be used.

ONTARIO.

Fort William, Ont.—A permit has heen issued to the Canadian Pacific Railway for the erection of a gas plant to supply illuminating gas to the cars.

St. Thomas, Ont.—Tbe water commission has a surplus revenue of $18,500.

Fort Frances, Ont.—Fort Frances is planning to huild its own electrical power plant. The city council and council of the Board of Trade have paid a visit to the Whitehorse rapids, about twenty miles north of the towu and all the members are favorable to the municipal development of power. It is understood that several thousand horsepower can he developed and the council feel that it would be unwise to give any private corporation the opportunity of gaining control of the power. The development would be placed under the entire control of the Hydro-Electric Commission which has offered to make a thorough investigation of the possihilities of development.

Welland, Ont.—On August 6th Welland carried the Hydro-Electric by-law to provide for an expenditure of $45,000 for a municipally owned plant. The vote was almost 2 to 1 in favor of the hy-law, notwithstanding a desperate attempt was made to defeat it.

Hamilton.—The local Hydro-Electric Board was notified on August 7th hy Hon. Adam Beck that the Hydro-Electric Commission has reduced the price of power to the city from $17.92 to $17 per horsepower. The city applied for a reduction to $17.50 to wbich it became entitled owing to its power load reaching nearly 2,000 horsepower for July, but the reduction of nearly $1 per horsepower came as a pleasant surprise.

QUEBEC.

Drummondville, Que.—A fire broke out recently in the electric powerhouse here. The huilding was completely destroyed, the damage being estimated at $30,000 of which $7,000 only is covered hy insurance.

CATALOGUES RECEIVED.

The Garlock Packing Co., Hamilton, Ont., are handling three lines of bahbitt metal which are meeting with good success. The Premo habbitt is a tough, copper-hardened alloy especially adopted for use on motors, dynamos, heavy duty saw mills, etc., where a tough high-grade babhitt is required. The Wentworth hrand is designed epecially for high-speed machinery of all kinds. It will run under exceptionally bigh speeds without heating. Prairie habbitt is a very high-grade metal suitahle for any class of work.

The Green Engineering Co., Chicago, Ill., have favored us with copies of their catalogues G and No. 8. The former deals with the well-known Green chain grate stokers, which are huilt in widths up to as much as 14 ft. wheu required. It is claimed that hoilers aggregating over one million horse power are now being fired by Green stokers, which forms a striking testimonial to the efficieucy and reliahility of these grates.

Catalogue No. 8 deals with the same firm's Geco pneumatic ash handling systems, in which a conveyor pipe is located convenient to the ash pits and is provided with openings to which the ashes are raked. A current of air at once sucks the ashes into the pipe and couveys them at high velocity to a separator and storage tank, where they are automatically sprayed and quenched. The necessary air current, through the conveyor pipe, is produced hy an exhaust fan driven in any convenient mauner. This fan withdraws from the separator tank, through a dust collector, the air admitted at the open end of the pipe line, and discharges same to the chimney or atmosphere. The advautages claimed for this system of conveying ashes are:—Reduced cost of handling ashes; reduced cost of maintenance; simplicity and cleanliness of operation; safety to operatives and property; adaptability to various conditions and situations.

The Chicago Pump Co., 906 W. Lake St., Chicago, who are exhibiting at the present Toronto Exhibition, have forwarded copy of Catalogue B, dealing with their automatic electric condensation pumps for drawing condensation and air out of heating systems, and automatically returning the water to the boilers. The system is operated independently of the boiler pressure, no vacuum pump being used. Instead the coudensation flows to a horizontal cylindrical receiving tank, which rests and oscillates on two trunnion boxes. The tank gradually fills up until the weight of the water overbalances an adjustahle counterweight, tilts the tank aud closes an automatic regulating switch, thus starting up the motor and multi-stage turbine pump. In this manner the water of condensation is returned to the hoiler, after which the tank tilts back to its normal posltion, ready to repeat the operation when the tank is again filled. The action of the pump in emptying the tank of course reduces the pressure in the latter, which acts on the heating return line, effectively pulliug the water and air out of the system. Partles interested in heating systems would he well advised to secure a copy of this catalogue.

The Dunlop Tire & Rubber Goods Co., Ltd., Toronto, have issued their 1912 catalogue of fire hose and accessories, which may he had on application hy those interested.

The Green Fuel Economizer Co., Matteawan, N.Y., have recently puhlished an extremely well gotten up catalogue, setting forth the merits of the Green fuel economizer and feed water heater. This, as is generally known, consists of a group of vertical cast iron pipes installed in the smoke flue hetween the boilers and chimney. These pipes are fitted lnto top and bottom headers, and the boiler feed water is forced through them, ahstracting a large part of the heat carried by the waste gases. The soot deposited upon the tubes is constantly removed hy mechanically operated scrapers. These economizers have to date been applied to hoilers generating some 60 million horse power, their use in Great Britain and Germany being well nigh universal.

Boulton & Paul, Ltd., Norwich, England, have sent us a copy of their catalogue No. 190, which shows the various types of gasoline and kerosene engines built by this firm for electric lighting, marine and industrial purposes.

The Standard Pump & Engine Co., Cleveland, Ohio, will be glad to mail to those interested copies of their new catalogue No. 12, which has just been published. Geared rotary, centrifugal, deep well and other pumps are illustrated, together with diagrams of the various water handling systems for which each type is suited.

A. Wyckoff & Sons, Elmira, N.Y., have sent us a small leaflet and price list showing the Wyckoff improved steam pipe covering. This covering is manufactured from Gulf cypress, a wood that is not affected by the alternately wet and dry conditions that usually exist in a steam pipe trench. Next to the pipe there is a 2-inch inner shell of the wood, then a ¼-inch dead air space (packed at the joints with a ring of asphaltum), then a 1-inch outer covering wound with galvanized wire.

The Maihak Indicator Agency, 3 Beaver Hall Square, Montreal, have published a catalogue dealing with the Maihak Indicator. This device has an outside spring. The catalogue also deals with appliances for measuring indicator diagrams and testing apparatus for indicator springs. Various types of planimeters are also shown. Another booklet giving prices, shows types of hand tachometers, surface speed and cut-meters, stationary tachometers, stationary tachographs, pocket revolution counters, and stroke counters. Copies of these will be sent free on request.

The Jeffrey Mfg. Co., Montreal, Que., and Columbus, Ohio., have sent us a copy of their new general catalogue—No. 82. This is an extremely handsome clothbound, 9x6 volume of 576 pages. The first 64 pages are taken up with numerous half-tones illustrating various plants fitted out with Jeffrey equipment. These include steam plants, lumber mills, mines, etc., etc. Every type of conveyor is shown, and dump cars, electric mine locomotives, coal cutting machines, coal crushers and many other lines are listed. Apart from its intrinsic value, the catalogue is attractive on account of the excellent printing and general get up.

The Stern Sonneborn Oil Co., Ltd., Finsbury Sq., London, E.C., have sent us a descriptive price list of a new sight feed lubricator for all kinds of machinery bearings, which they have recently put upon the market. The lubricator, which is known as the "Flotteur" sight feed, operates on the syphon principle. The long leg of the syphon forms a central stem, down which the oil passes to the bearing; while the short leg consists in part of a sliding sleeve attached to a float, so that the mouth of the short leg is always slightly below the surface of the oil. A uniform rate of flow is thus maintained until the container is practically empty, since it does not depend upon the "head" of oil, but solely upon atmospheric pressure. Any dirt which may accidentally get into the oil will sink to the bottom and cannot reach the bearing, because the supply passes into the syphon from the upper level of the oil, and not from the bottom. The rate of flow can be readily adjusted, and when once fixed requires no further attention. This lubricator is made in six sizes, with capacities varying from ⅛ pint to 1¾ pints.

The Jones Underfeed Stoker Co., Montreal and Toronto, have favored us with a copy of their catalogue, which fully illustrates and describes their well-known stoker and shows its application to various types of boiler. The Jones underfeed stoker, it is claimed, enables low grade coal to be consumed with entire absence of smoke, and maintains a constant boiler pressure, because the supply of coal to the furnace and the amount of air necessary for complete combustion are automatically controlled by the steam pressure itself.

The Nelson Valve Co., Philadelphia, Pa., have issued a new catalogue and price list of their steel valves and fittings for very high pressures and superheated steam. This list to a large extent cancels that published in 1909. Parties interested should ask for catalogue S.

The Lunkenheimer Co., Cincinnati, Ohio, have sent us a copy of their 1912 catalogue, a handsomely bound book which commemorates the fiftieth anniversary of the company's business existence. Attention is called to the fact that alterations have been made in list prices in many cases. Revised lists or those differing from previous editions are indicated by an asterisk after the folio numbers of the pages on which such lists appear.

Catalogue No. 86, describing the Improved Chambers Throttle Valve, has just been issued by the Watson-Stillman Co., 50 Church St., New York. This valve is said to be superior to the ordinary throttle valve in the following particulars: A single seat, regrinding without removal, no lost motion, internal boiler inspection without removal, takes driest steam from highest point in dome, perfect balance, easy operation, and screw or lever control.

BOOK REVIEWS.

The book **"Feed Water Filtration,"** published by James Beggs & Co., 36 Warren St., New York, has been in such demand that a fourth and revised edition has just been issued. This book deals with the removal of organic matter, oil, grease, and other floating particles from from boiler water, and illustrates and describes numerous installations of the Blackburn Smith Feed Water Filter and Grease Extractor. A free copy will be sent by James Beggs & Co. to anyone interested.

"A New Analysis of the Cylinder Performance of Reciprocating Engines," by J. Paul Claytou, has just been issued as Bulletin No. 58 of the Engineering Experiment Station of the University of Illinois. For many years the only accurate method of ascertaining the steam consumption of an engine has been to measure or weigh in some manner the water used. It has been discovered, however, that the quality of the steam present in the cylinder at cut-off controls the form of the expansion curve of the indicator diagram in a perfectly definite way. From this fact there has been developed a method of computing the steam consumption of an engine from the indicator diagram alone to within 4 per cent. of the actual consumption as measured by test. There has also been developed a method of obtaining the volumetric clearance of a cylinder using steam, gas, air, or ammonia to a degree of accuracy almost as great as the method of filling the clearance space with a known weight of liquid. The bulletin contains an exposition of the methods employed in obtaining the steam consumption and clearance, and also methods of detecting leakage from the indicator diagram with the engine in regular operation. Copies of Bulletin No. 58 may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

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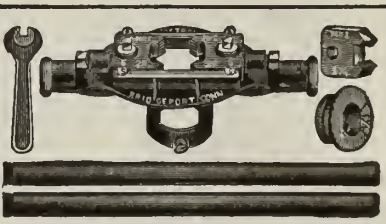

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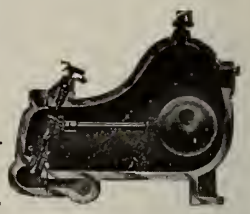

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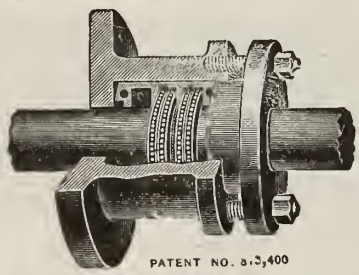

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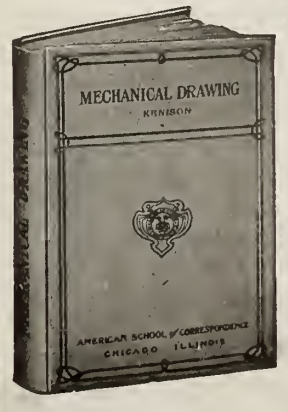

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Try **ALBANY GREASE** at our expense.

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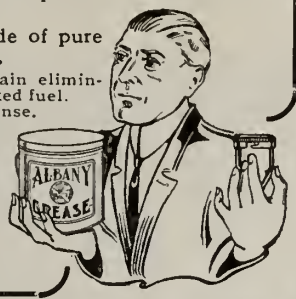

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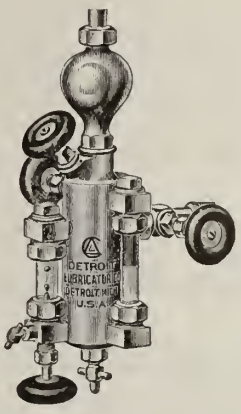

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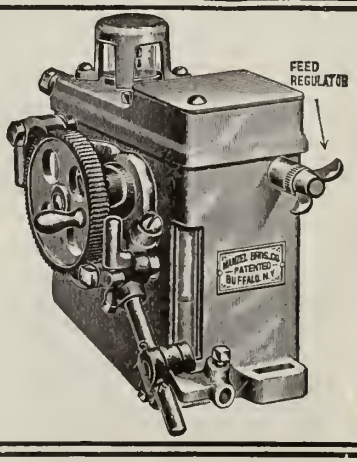

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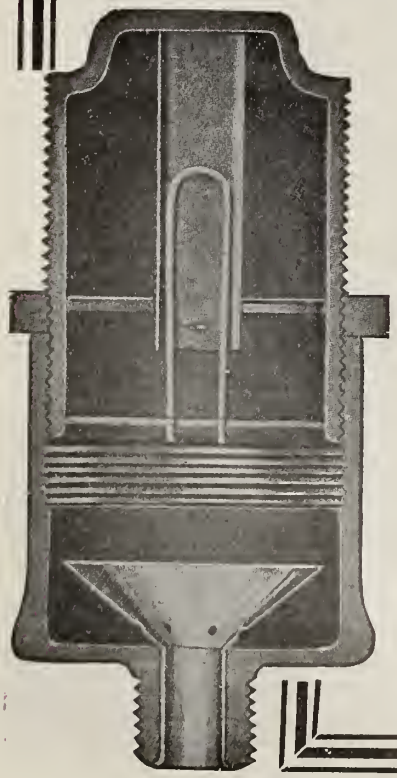

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It is the most economical Belting because it is durable under every condition; even where other Belting will deteriorate rapidly. It is water proof.

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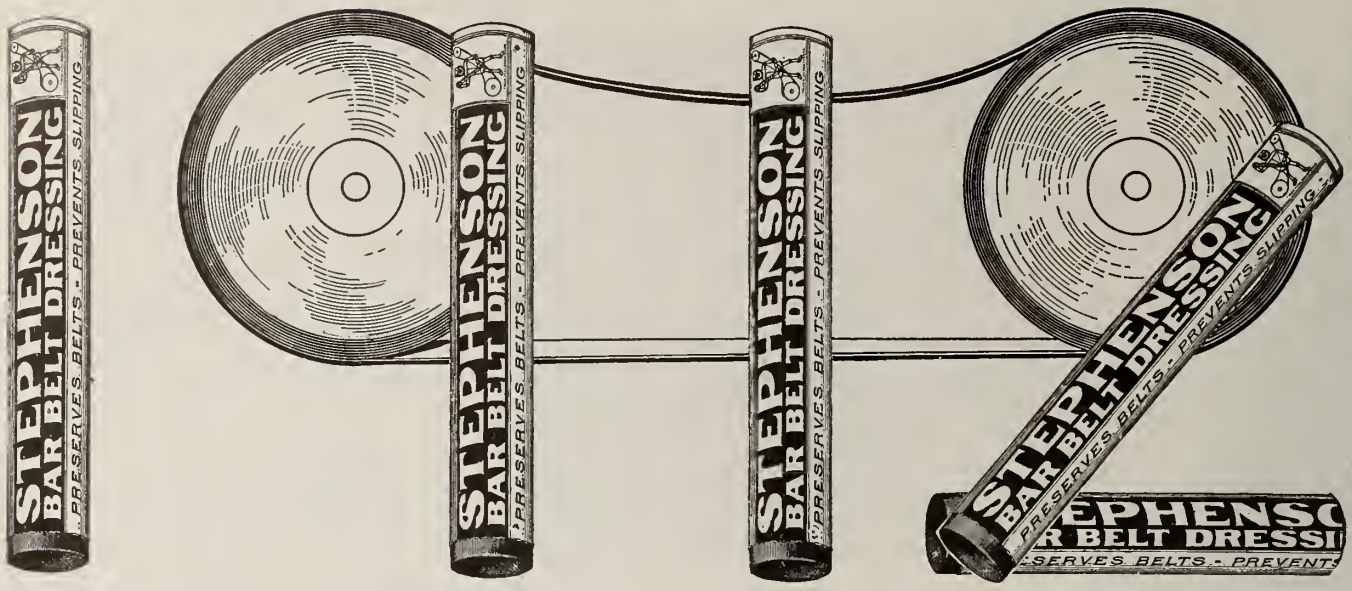

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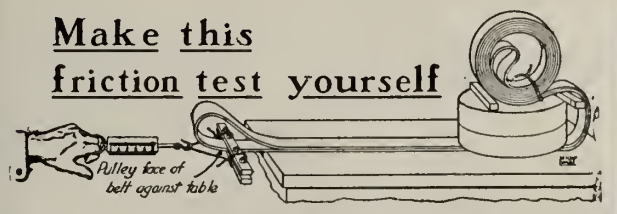

Here is an easy way to compare the pulling qualities of a Cling-Surface-treated belt with those of an untreated belt. Select some good smooth clean surface, take belts that have seen equal service, load slightly as shown and with contact side down. Be sure that the surface of the weight in contact with belt is perfectly flat. You will find an astonishing difference in pull required to make the untreated and the treated belts slip, although the belts treated with Cling-Surface have just as clean a face as the other.

There is nothing paradoxical about this. Cling-Surface simply gets into and around every fiber in the belt, makes the belt so pliable and the face so mellow that every bit of the surface under the weight comes into intimate contact. Thus the frictional resistance is increased without making the belt face sticky. The cling in the belt face and flexibility of the interior promote cohesion. The belt grasps and lets go without effort, where with a sticky preparation, the belt and the pulley tear apart.

After this test has convinced you that there must be something in the claims for Cling-Surface, select just one troublesome belt for Cling-Surface treatment, and if you don't find on comparison with the other belts that the service has been greatly and lastingly improved, that the initial tension can be reduced without slip, we won't charge you a cent for the Cling-Surface used.

Wide awake engineers who endeavor to maintain the highest belt efficiencies, highest shafting efficiencies, a saving of belts, oil, babbitt and fuel, and do so with the least amount of attention and worrying, are quick to appreciate Cling-Surface. Any belt treated with Cling-Surface is dependable while running slack or easy, is kept flexible, soft, preserved, waterproofed and in best condition always. The preservation of the belting itself will far more than repay the cost of Cling-Surface treatment and is but one of the small benfits therefrom.

Make the trial or at least send for literature.

Cling Surface Co

1057 Niagara St Buffalo N Y

44

"AMPHIBIA"

(Waterproof)

and

"CLIMAX"

Leather Belting

Costs less per day

of Service

than any other.

Let that fact "sink in," then get one belt and keep tab on it.

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Tanners and Manufacturers

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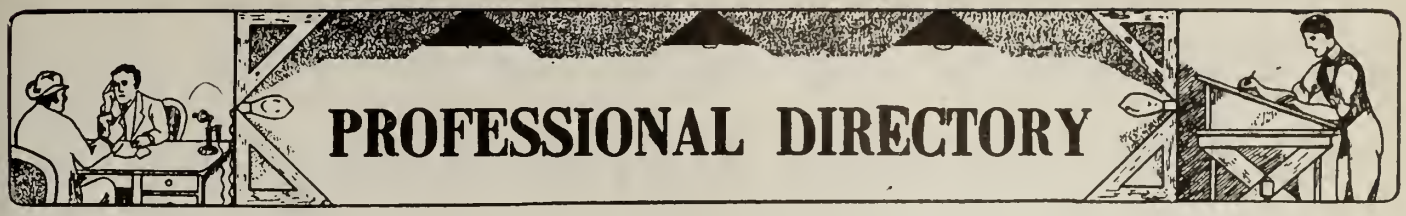
¶ "He must know before he begins it that he must spend money—lots of it.

¶ "Somebody must tell him that he cannot hope to reap results commensurate with his expenditure early in the game.

¶ "Advertising does not jerk; it pulls. It begins very gently at first, but the pull is steady. It increases day by day and year by year, until it exerts an irresistible power."

The advertiser would like to know where you saw his advertisement—tell him.



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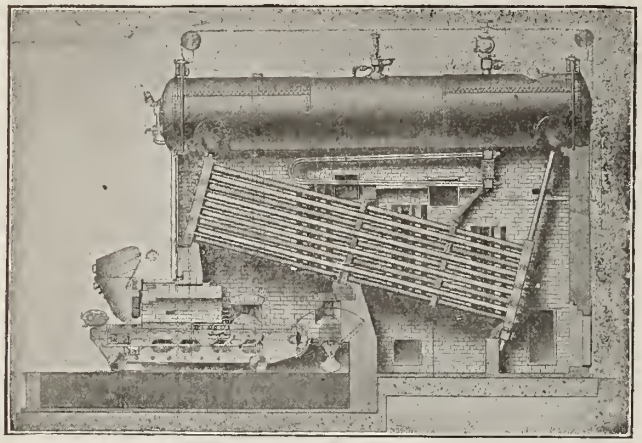

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British Pacific Supply Co., Victoria, B. C.
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Can. Oil Companies, Ltd., Toronto.
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Goldie & McCulloch Co., Galt.
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Darling Bros., Montreal.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Hare Eng. Co., Toronto.
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General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.

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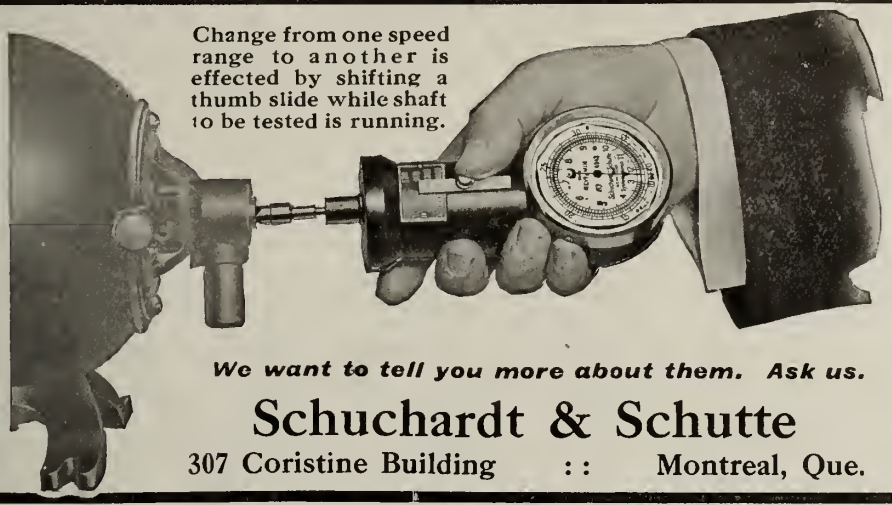

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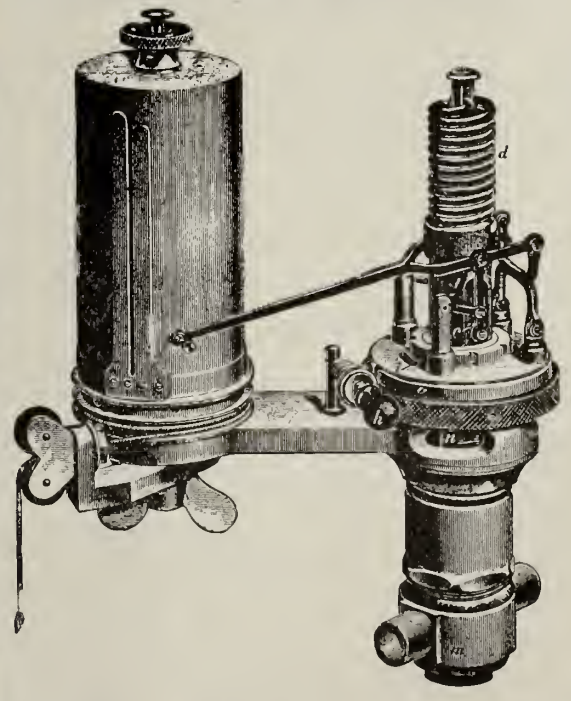

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General Supply Co. of Can., Ottawa.
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J. C. Wilson & Co., Glenora, Ont.

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Can. Fairbanks-Morse Co., Montreal.
General Supply Co. of Canada, Ottawa

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Asbestos & Rub. Goods Co. Toronto
Canada Fdry Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Can., Ottawa.
Liberty Mfg. Co., Pittsburg, Pa.
H. L. Peiler & Co., Montreal.
Vulcan Tube Cleaning Systems, Ltd., Montreal.

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Turbine Water Wheels.
Canadian Boving Co., Hamilton.
Chas. Barber & Sons, Meaford, Ont.
Escher, Wyss & Co., Toronto.
Jenckes Machine Co., Sherbrooke, Que.
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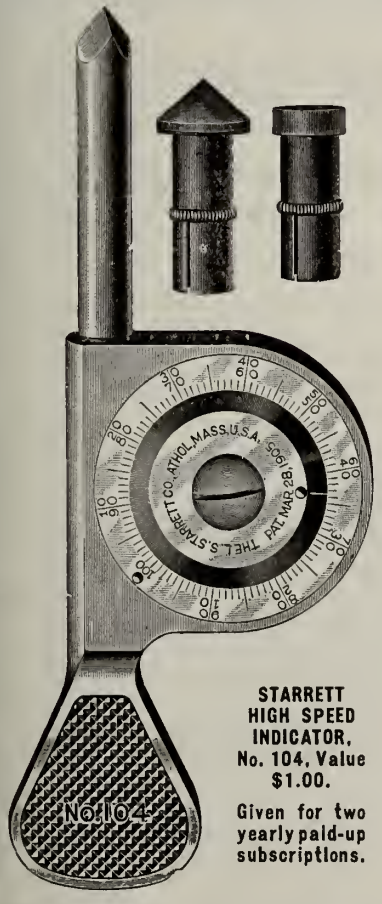

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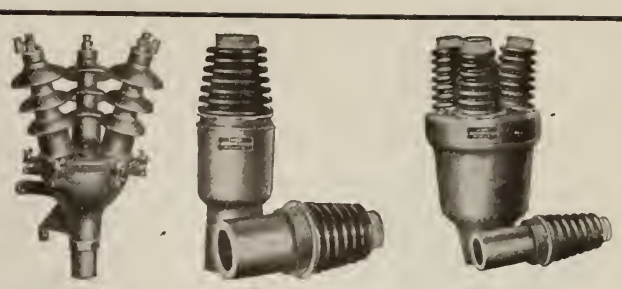

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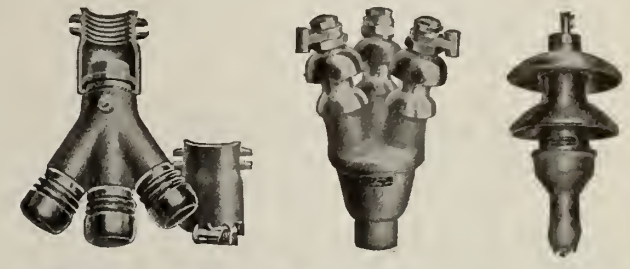

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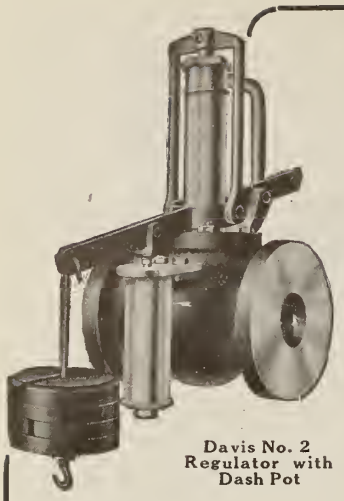

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USE STEAM ECONOMICALLY

Steam costs money — it represents coal, mechanism, labor. Then why not use it economically?

Wherever steam is used, various pressures are required to give the most efficient results. Some apparatus may need only 50 pounds—some 25 pounds—some, perhaps, will operate on 5 pounds. Yet, in many plants where the boiler pressure is high, steam is used throughout at the initial pressure—not the required pressure. Needless loss goes on every minute of the working day.

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The DAVIS PRESSURE REGULATOR

"—a safeguard against the needless waste of steam."

No matter whether you want a certain pressure for an engine, pump, heater, cooking kettle, dry kiln, heating system or whatever local conditions may demand—here's an automatic valve which will give you a constant, steady service pressure.

There are no delicately adjusted parts to a Davis Regulator—no springs, packing, toggles, auxiliary valve, diaphragm, or small ports.

You can always depend on it for continuous efficient service regardless of the operating conditions.

And better, the Davis Regulator is sold entirely on its own merit. You test it in your own plant—then if not satisfied we take it back—you're under no obligation whatever.

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Five reasons why Westinghouse construction is best for large, high-voltage, oil insulated, water-cooled transformers.

1. Air-tight construction prevents breathing. A vent is provided to relieve any undue pressure which might arise inside the tank.
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Homer Street,
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"The Choice of the Engineers who Know"

STEAM COCKS

Our ENGINEERS' Goods and Steam Specialties are well and favorably known. For over twenty-five years they have been giving the right kind of service—a service that spells economy to the user.

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GET OUR COMPLETE CATALOGUE

GLOBE VALVES

INJECTORS

LEVER THROTTLE VALVES

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THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143 149 University Ave LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. V. Publication Office, Toronto—September, 1912 No. 9

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Made in both Double and Single Connection.

SIGHT FEED LUBRICATORS

Are Always Satisfactory

BECAUSE

They Give

"ALL THE LUBRICATOR COMFORTS"
AND ARE THE POPULAR CHOICE OF LEADING ENGINEERS EVERYWHERE.

Some Convincing Proofs why the Peerless is the best Lubricator.

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Do not accept substitutes. Get the genuine Peerless.

Manufactured by

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ENGINEERS AT REMOTE PLACES ALL OVER THE GLOBE DEMAND THE PACKING THAT HAS PROVEN ITSELF TO BE THE "BEST BY TEST"

MANUFACTURED EXCLUSIVELY BY

PEERLESS RUBBER MANUFACTURING COMPANY

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H. D. EDWARDS & CO.

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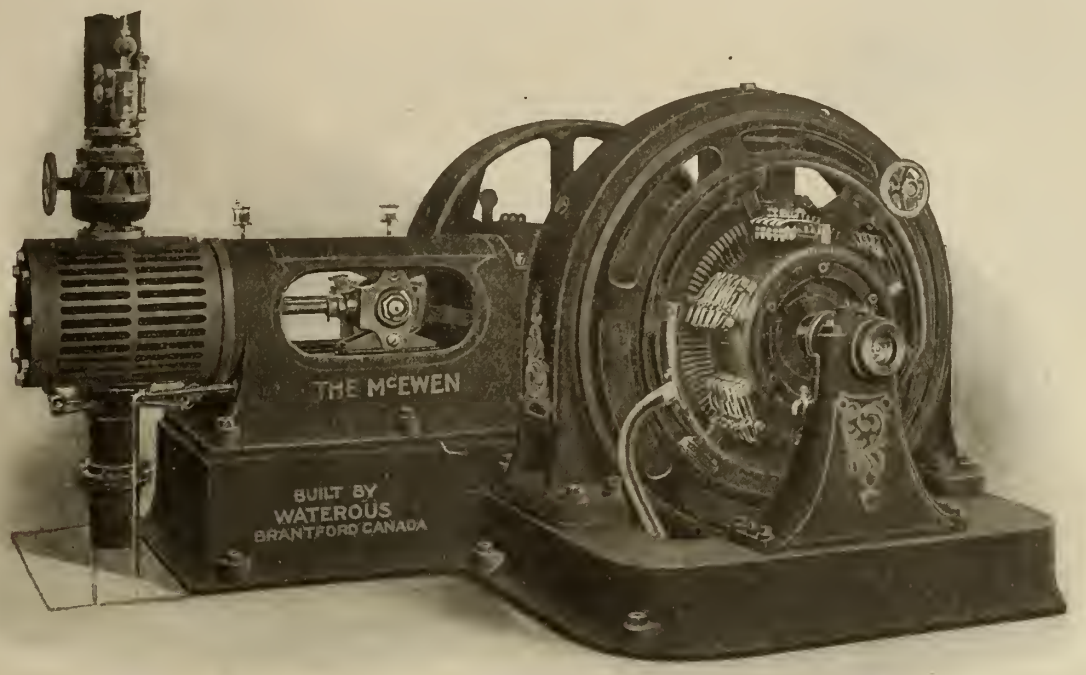
Sole Agents and Distributors for the Dominion of Canada.



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Send for the McEwen Booklet.

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"Cut Out The Sunday Work"

No engineer, who uses P. P. P., spends his Sundays packing his engine. THREE rings of P. P. P. will keep an engine packed for months. And when a leak or blowing does appear, all you need do is to add a new ring of the packing to extend the wear for weeks.

DANIEL'S ROD PACKING **P. P. P.** **"REGULAR" "SPECIAL" "MARINE"**

is built on scientific principles — the packing fits snugly to the rod when there is need of maximum resistance to the escape of steam, and as the pressure is reduced, by expansion of the steam, the bearing of P. P. P. on the rod decreases in exact proportion to the decreased requirement. This prevents wear on the packing and saves a whole lot on coal bills. There's no unnecessary friction to overcome. This is just plain common sense, yet P. P. P. is the only packing really built on this principle.

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TO ENGINEERS

The thousands of requests for our Engineers' Blue Book encourages us to offer an entirely new one, FREE.

The name of the book and a description of its contents will appear in the October issue of this magazine.

Watch for it.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods
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Horizontal Tubular, Vertical Tubular and Locomotive Types.
In all sizes, and for medium or high pressures.

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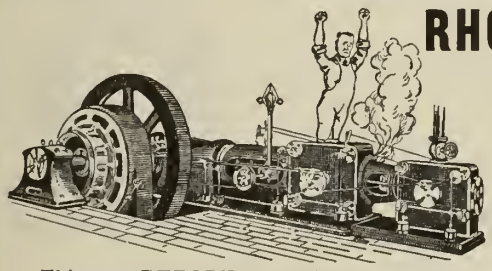
RHODES IMPROVED METALLIC PACKING

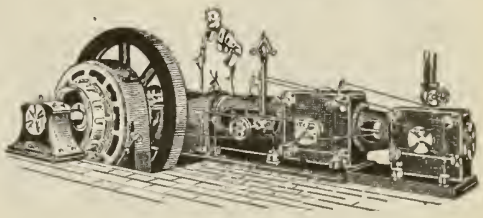


This was BEFORE he used our packing.

THE PACKING THAT PACKS

A trial will convince you.

Beware of Imitations.



This is AFTER he installed our packing.

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In Cans 6, 12, 25 and 50 lbs.

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LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

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Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
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The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

Practically Frictionless

Sold on APPROVAL

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THEY ARE FOR VALVES OF THE JENKINS TYPE
AND ARE MADE OF COPPER AND ASBESTOS

One Goetze's Valve Gasket will outlast six rubber discs, because it will not crack and go to pieces as rubber does. That's why Goetze's Valve Gaskets are cheapest from beginning to end.

Order your new valves fitted with Goetze's Valve Gaskets and have no more trouble with leaks. Use Goetze's Valve Gaskets to give your old valves a new lease of life. Only be sure you get *Goetze's*.

That Joint That Gives You So Much Trouble Can Be Made *Tight*

To put a gasket on the least troublesome flange joint in your plant is no real test of the value of that gasket. Put it on the *worst* joint, the one that is always giving you trouble, and you'll find out whether it is any good for your purpose or not.

We tell you that you can put a complete stop to all trouble due to leaky flange joints, that you can make that joint which gives you so much trouble absolutely tight

By Using Goetze's No. 2 Gaskets

And we are willing to prove it to you by shipping you any quantity on *90 days' trial*—no charge if they do not make tight joints and *hold* them tight under all pressures and temperatures. Try them. Write us to-day what sizes and quantities to ship. Remember, they do not cost you a cent unless they do the work. And be sure to ask for a copy of our Illustrated Catalog of Packings for all Power Plant Purposes.

Goetze Gaskets are carried in stock by

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70 Cedar Ave.

WINNIPEG
C. E. Chown, 147 Bannatyne Ave.

VANCOUVER
A. O. Campbell, 1069 Hamilton St.

MANUFACTURED BY

Goetze Gasket & Packing Co.

NEW BRUNSWICK, N.J.

TRADE THE GARLOCK PACKING CO. HAMILTON, CANADA. MARK

GARLOCK PACKINGS

On account of their superior qualities, are recognized as a standard packing for use under all conditions of service. Our Trade-mark is the passport by which we are known to those in need of reliable goods.

We have Packings to meet every requirement, and all you have to do is to write for information.

Garlock High Pressure Ring

Our handsomely illustrated catalog, descriptive of Garlock Packings and Pipe Coverings will be mailed on request.

Garlock Asbestos Gasket

"POINEERS IN THE PACKING BUSINESS."

The Garlock Packing Co.

Head Office and Works: HAMILTON, ONT.

Branches: MONTREAL, QUE., 412 St. James Street.
TORONTO, ONT., 77 Adelaide Street East.
WINNIPEG, MAN., 117 Market Street East.

TRADE JENKINS MARK
Jenkins Bros

Here's a Catalog

You Ought

to have—

The new

Jenkins Bros.

Catalog for 1912

It shows some new types of valves, including the new TYPE "K" brass and iron body gate valves; cast steel valves of extra heavy patterns for superheated steam and hydraulic service, extra heavy check and blow-off valves, automatic equalizing stop and check valves, additional styles of radiator valves—

As well as the standard Jenkins Bros. types you have known and used for years.

Compact—handy—brimful of information for the man who's interested in valves, packing and other mechanical rubber goods for the power plant.

Send for your copy to-day.

Jenkins Bros., Limited

103 ST. REMI STREET

MONTREAL

DART

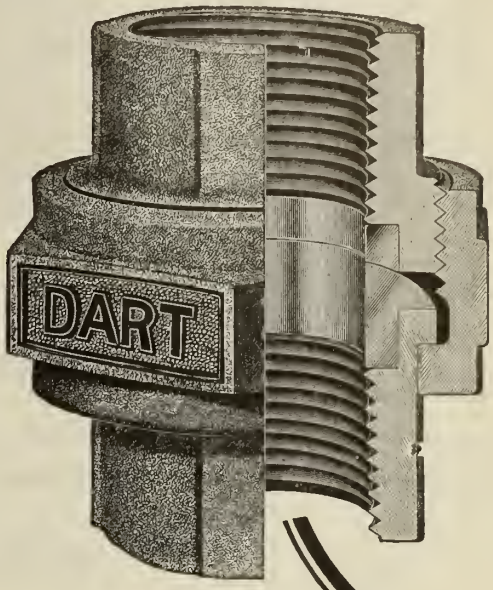
Unions never leak

The seats of the

Bronze to Bronze ball shape ground

JOINTS

cannot rust or corrode nor the heavy iron parts stretch or pull apart.



The " DART " Union can be connected and dis connected as often as desired without impairing its efficiency.

The " DART " Union has no maintenance cost, and does not have to be replaced.

It positively eliminates all loss due to leaks. Makes joints quickly whether pipes are in or out of line.

YOUR GUARANTEE

Our Trade Mark DART is cast on every Union that we ship. It represents all our claims, and if any Union, bearing this mark, is found defective, or in any way not as we say, we will replace two for one, or refund your money.

" DART " Unions are sold by nearly all dealers, and are made in screwed, flanged, tee and elbow types ; male and female.

If you do not use Dart Unions in your plant let us send you samples. Prove their efficiency and see what expense they will save.

DART UNION CO., Limited

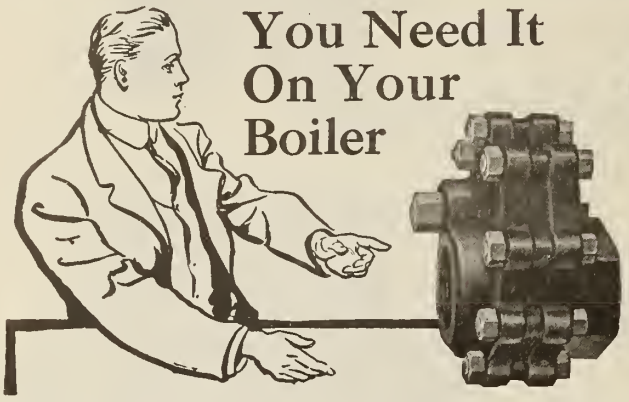
93-97 Niagara Street, TORONTO, ONT.

A GOOD INVESTMENT

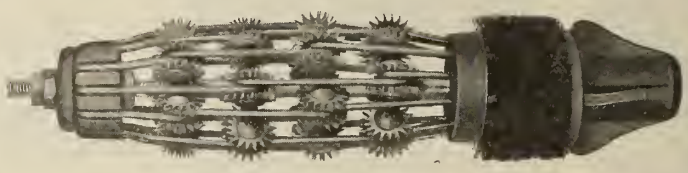
IS MONEY SPENT IN KEEPING THE BOILERS CLEAN

HERE ARE TWO OF THE BEST MEDIUMS

"EVERLASTING" BLOW-OFF VALVE—THE "FLEXIBLE" TUBE CLEANER



You Need It On Your Boiler



The "FLEXIBLE" Tube Cleaner does a better job with half the labor. It rolls through the tube. Sent on trial if desired.

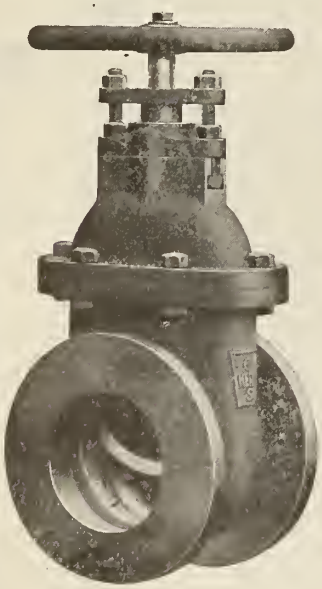
Engineering Specialties Company

1080 King Street West — **TORONTO, ONTARIO**

H. L. PEILER & CO., 380 St. James Street, Montreal

AGENTS:
THE A. R. WILLIAMS MACH. CO. OF ST. JOHN, N.B., LTD., St. John, N.B.

P. D. McLAREN, LIMITED, Calgary, Alta.



6″ Flanged End Kerr Gate Valve

When next you order an Iron Body Gate Valve, Specify

Kerr's New Pattern

LIKE THIS ILLUSTRATION

We want you to see and try what we know to be the strongest and best made Valve on the market for Standard Pressure. Every Valve tested 300 pounds Hydraudlic Pressure.

THE KERR ENGINE CO., Limited

WALKERVILLE, **ONTARIO**

The advertiser would like to know where you saw his advertisement—tell him.

LUNKENHEIMER SUPERIOR STEAM BOILER VALVES AND FITTINGS

CONFORM WITH THE NEW CANADIAN BOILER REGULATIONS AND ARE APPROVED FOR USE IN WESTERN CANADIAN PROVINCES, INCLUDING BRITISH COLUMBIA, ALBERTA AND SASKATCHEWAN.

The line approved includes globe, angle, cross, check, gate, blow-off and pop safety valves, water gauges, gauge cocks, etc.

A complete list of official registration numbers covering the above will be sent upon request.

The supremacy of LUNKENHEIMER PRODUCTS is universally acknowledged, and to maintain this reputation, the highest type of skilled labor is employed and only new material of the very best grade is used.

We guarantee our goods to be of the very highest quality, and a LUNKENHEIMER GUARANTEE is a real. definite quantity and not an empty use of the meaning of a guarantee.

All correspondence and inquiries receive prompt attention, and immediate shipments are assured, as large stocks are carried.

Our products are carried in stock by most supply houses. Those that do not carry them can get them for you, but if they will not, write us.

WRITE FOR 1912 CATALOGUE.

THE LUNKENHEIMER COMPANY

Largest Manufacturers of High-Grade Engineering Specialties in the World.

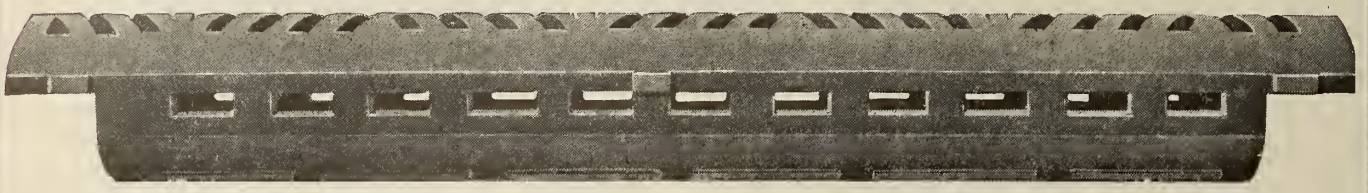
GENERAL OFFICES AND WORKS:
CINCINNATI, OHIO, U. S. A.

NEW YORK, 64-68 Fulton Street.
BOSTON, 138 High Street.
CHICAGO, 186 North Dearborn Street.
LONDON, S.E., 35 Great Dover Street.

The advertiser would like to know where you saw his advertisement—tell him.

Your Steam Supply LOW and Coal Bills HIGH?

THOMAS ELLIPTIC GRATE BARS



INCREASE Steam Supply, DECREASE Coal Bills.

Cost Less by Lasting Longer. Make more Steam by Increasing Combustion.
Save Fuel by Better Burning the Gases. Save Labor by Reducing Fuel and Cleaning.

KILBY FROG & SWITCH CO.

Birmingham, Ala., August 12th, 1912.

Thomas Grate Bar Co., Birmingham, Ala.

Gentlemen: We have been using the "Elliptic Grate Bars" continuously for the past year, and they are giving us the best of satisfaction. We have not had occasion to renew these bars since we first installed them, and find, after careful watching, they are far superior to the old style bars, not even shown any signs of deterioration since installation.

We heartily recommend them unreservedly to any firm or corporation wanting high grade bars, as they reduce the cost of coal to a minimum.

Yours truly,
KILBY FROG & SWITCH CO.,
(Signed) C. H. Krauss, Superintendent.

WOODWARD LUMBER COMPANY,

Augusta, Ga., August 16th, 1912.

Hickman, Williams & Co., Birmingham, Ala.

Gentlemen: Answering your letter of the 15th, in regard to Thomas Grate Bars, beg to say that we could not give you, with any degree of certainty, the percentage of fuel saved over the old grate bars, as we have never given this matter a practical test. We burn shavings in two of our boilers and R.M. coal in the third; in both instances the bars are very satisfactory, as a matter of lasting qualities, they are beyond anything we have ever used. This particular feature led us to make our first purchase of Thomas Grate Bars, and we find that they will last two or three times as long as any other grate bar we have ever used, thus saving a great deal in renewal.

Yours very truly,
WOODWARD LUMBER CO.
(Signed) J. C. LEE, President.

Solving others' STEAM troubles, WHY NOT YOURS?

Write to-day for STEAM TROUBLES FOLDER

The General Supply Co. of Canada Ltd.

OTTAWA, TORONTO, WINNIPEG.

Thomas Grate Bar Co., Birmingham, Ala., U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

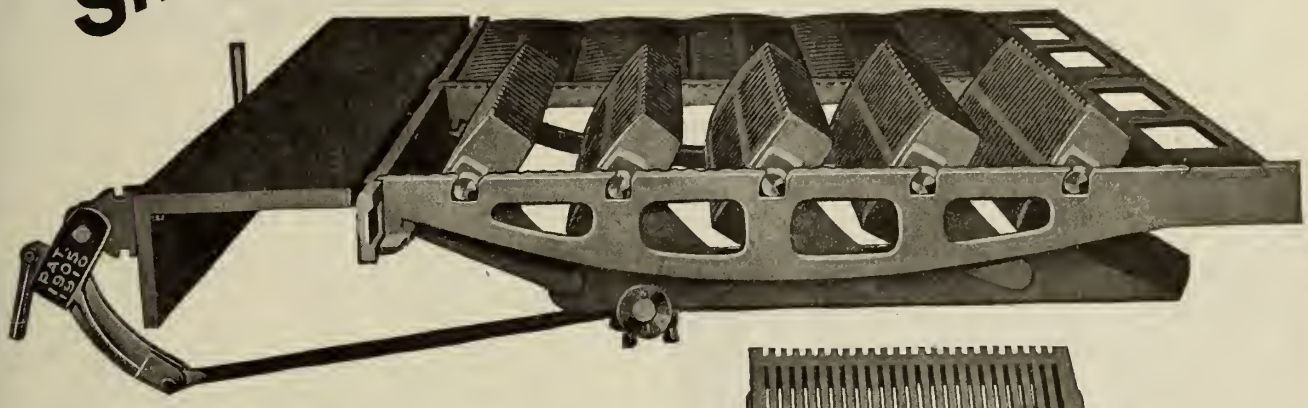
The Grate That's Imitated

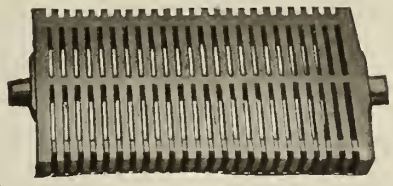
The Cheapest Grades of Fuel can be Burned with Results Equal to that of the Best.

"THE Cyclone" Shaking and Dumping Grate Bar

" Imitators only copy the Best "

The "Cyclone" has been subjected to most rigid tests and has proved its superiority over all other makes. Don't let a Salesman tell you that the grate he represents is better than the "Cyclone." Ask him to prove it—he cannot.





The "**Cyclone**" **Grate Bar** embodies an immense improvement in the shaking apparatus, whereby all the ashes are passed through the grate. No fuel can go to waste.

The "Cyclone" allows 68% of air space, and 90% underdraught. **This greatly increases the production of steam** for amount of fuel consumed.

You don't have to take our word for it. We will send you a list of users—**write the user and get his verdict.**

Write for illustrated circular and price.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST - - - - TORONTO, CANADA

AGENTS

ST. JOHN, N. B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.

THERE are many methods of steam-raising just as there are many ways of wheat-raising, but there is only one BEST way. The one best way of steam-raising is to fire your boilers by means of "Bennis" machine stokers. You would scarcely attempt to dig by hand your wheat area! It is almost as futile to hand-fire your boilers and expect to raise a good supply of **cheap steam.**

"Bennis" Conveying Feed "Bennis" Chain Grates Automatically.

"Bennis" Stokers mean cheap steam, and cheap steam means "Bennis" Stokers, and that is the whole of the story. Cheap steam means high boiler duty without smoke from low-grade fuels—**"Bennis" Stokers** mean high boiler duty without smoke from low-grade fuels.

Cheap Steam means a rapid response to a varying load, without detriment to the boiler. "Bennis" stokers mean a rapid response to a varying load, without detriment to the boiler.

Write for ***"Boiler House Economy and Cheap Steam"*** pamphlets, and full particulars to

G. H. TOD, 213 Manning Chambers Queen St. West **TORONTO**

DOMINION SUGAR CO., Ltd., BERLIN, ONT.

ALL CONTRACTS SUBJECT TO STRIKES, ACCIDENTS, OR OTHER CAUSES BEYOND OUR CONTROL.

DOMINION SUGAR COMPANY, LIMITED.

WALLACEBURG, ONT. May 30th, 1912

ADDRESS ALL COMMUNICATIONS TO THE COMPANY

Messrs. Jones Underfeed Stoker Co., Limited,
TORONTO, Ont.

Gentlemen,-

We are pleased to advise you that the installation of the fourteen Stokers which we put in our Berlin plant last year, has given the most perfect satisfaction. We operated our Refinery at that plant for about 65 days, and saved slightly over half the total cost of the installation.

We are also placing an order with you, to equip the balance of our boilers at that plant, to be ready for our fall run.

Youre truly,
DOMINION SUGAR CO., Ltd.

DAG/M

General Manager

In 1910 the above Company operated their boiler plant *hand fired!*

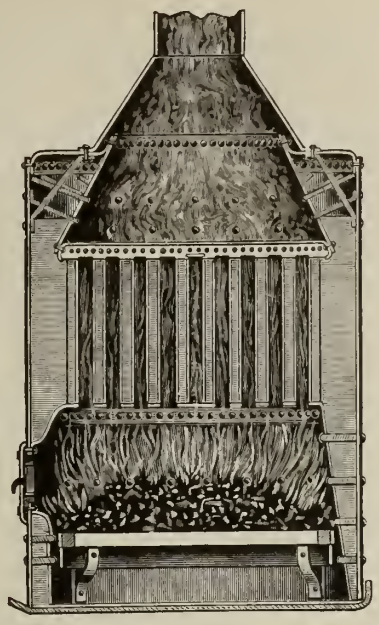
In 1911 they had 14 Jones Underfeed Stokers to do the firing!

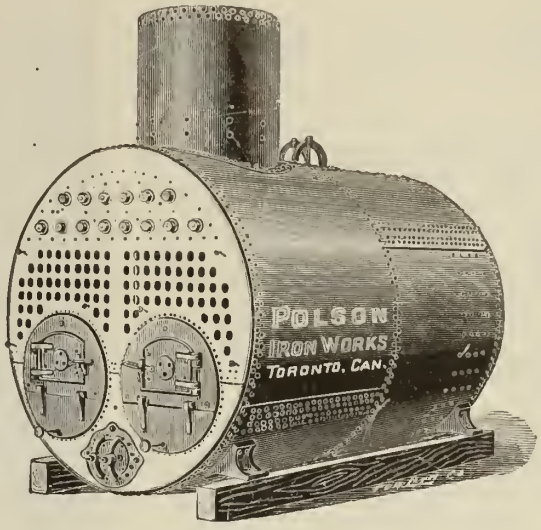
NOW they have 20 Jones Underfeed Stokers looking after their interests!

Their letter herewith states their *saving*—their *satisfaction*. The *saving* is all *their* own! Their satisfaction is *our* success!

JONES UNDERFEED STOKER COMPANY
LIMITED
NATIONAL TRUST BLDG. TORONTO

The advertiser would like to know where you saw his advertisement—tell him.





Marine Boilers

We build various types: Scotch, Clyde, Fitzgibbon, Vertical, Mosher.

Land Boilers

Horizontal, Tubular, Vertical, Locomotive Type, Water Tube, "Heine."

GENERAL PLATE WORK

THE BEST MATERIAL, MANIPULATED BY EXPERIENCED WORKMEN, ENSURES A FIRST CLASS BOILER.

We Employ Both. ***Consult Us.***

POLSON IRON WORKS, LIMITED

STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

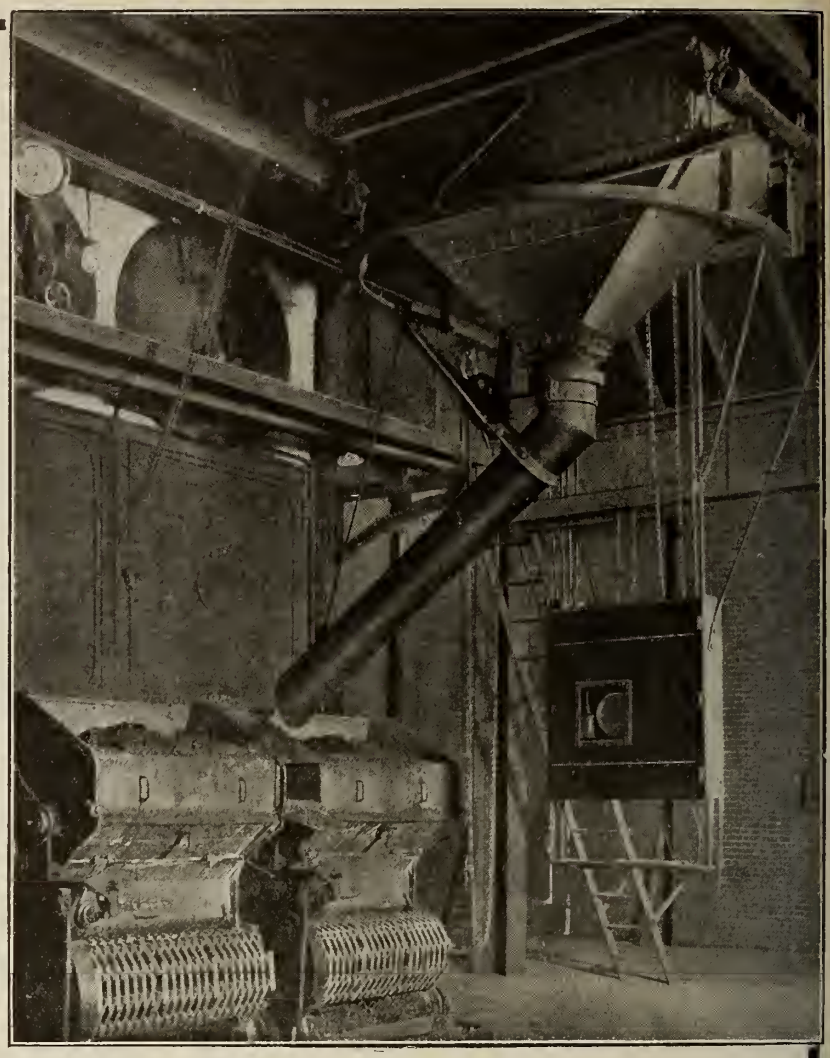
TORONTO **CANADA**

REPRESENTATIVES IN CANADA FOR

The B. F. Sturtevant Co., Hyde Park, Mass., U.S.A., Fans, Blowers, Heating and Ventilating
The John I. Thornycroft Co., London, England, Marine Motors

Do You Know to a Pound How Much Coal Your Boilers Burn?

Don't You Want to Know?



FAIRBANKS' SUSPENSION COAL SCALE
Montreal Tramways & Power Co., Limited

Not knowing, to the pound, how much coal your boilers burn, how can you determine with any degree of accuracy the efficiency of your boilers? The true energy-producing quality of your coal? The cost of your power?

We show here a one ton Fairbanks' Suspension Coal Scale, with quick weighing dial, installed in the Power House of the Montreal Tramways & Power Co., Limited. With this scale they can check to a pound the amount of coal the boilers use.

The scale hopper is mounted on a trolley which runs on a track in front of the boilers and this trolley is operated by means of a motor controlled from the floor below. The scale hopper is filled from the overhead coal bunkers, the coal weighed, and the trolley is then run along the track until it is opposite the boiler you desire to feed. There the coal is dumped into the feed hoppers of the automatic stokers.

This scale should be in every up-to-date power house. It can be adapted to meet your requirements. Let us know what the conditions are in your power house. Write for further particulars.

The Canadian Fairbanks-Morse Co., Limited

FAIRBANKS' SCALES—FAIRBANKS' VALVES—FAIRBANKS-MORSE GAS ENGINES, SAFES, VAULTS, Etc.

Montreal St. John Ottawa Toronto Winnipeg Saskatoon Calgary Vancouver Victoria

Ventilating a Valuable Fact

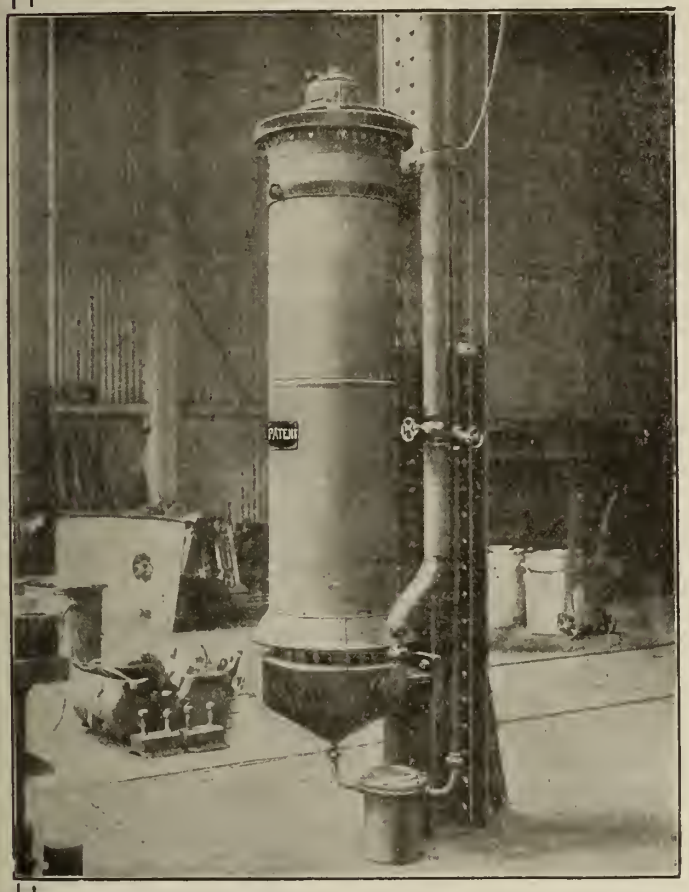
A Subject of Vital Importance to Your Business

It is a well established fact that a man working in a properly heated and ventilated shop can accomplish far more than the same man working in a poorly heated and ventilated shop. He can do more, and do it better, and stands a bigger chance of doing it day in and day out.

THE STANLOCK SYSTEM

of Heating and Ventilating

Inexpensive at the start and completely satisfactory in use. Adopted by many leading engineers and big manufacturers in this country and Europe.



The System

This system consists of units as shown below. They are made of steel tubes screwed into circular cast iron bases and through these tubes steam passes. Enclosing these tubes is a sheet metal cylindrical casting with a motor at the top. The air is forced downwards, thus keeping the floor warm. A special pipe can be fitted, passing through the roof or through the side wall, thus giving a supply of fresh air. Dampers are provided so that the inside air can be circulated or outside air can be taken in and heated. Can be installed in old or new buildings.

Its Advantages

1. No overhead air ducts are required.
2. No underground masonry ducts are required.
3. No obstruction to light due to overhead air ducts.
4. No heat losses due to radiation from air ducts.
5. Minimum of power absorbed.
6. Units hung on walls. No floor space needed.
7. Various units operated independently and can be turned on or off like radiators. Some supply fresh heated air and others merely circulate and heat.
8. A unit using 60 lb. steam pressure heats 3,600 sq. ft. of floor space.
9. The first cost of apparatus is very low.
10. Units may be added at any time in case of extensions, and in case of boiler shops, units may be removed entirely during the summer months, if desirable.

IT WILL PAY YOU TO ASK US FOR COMPLETE INFORMATION AND AN ESTIMATE ON YOUR REQUIREMENTS. DICTATE A LETTER TO-DAY

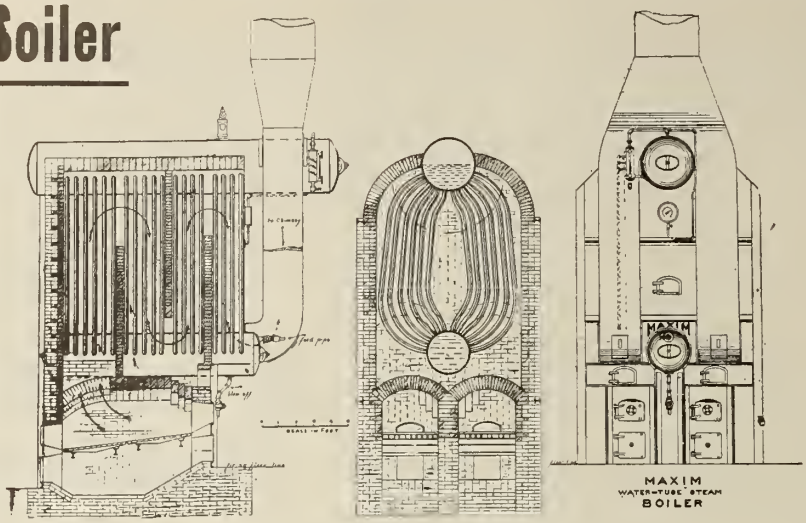
THE GARTH COMPANY

Sole Canadian Agents

26-32 Craig Street, Montreal

The advertiser would like to know where you saw his advertisement—tell him.

The Maxim Boiler



Do you understand the purpose of a feed water heater? Well, have you used an economizer? If your boiler carries steam at 100 pounds pressure, the temperature of the steam (and therefore the water in the boiler) is 338 degrees. If you get your waste gases down to 500 degrees you are doing well. This is where an economizer comes in. The waste gases are carried through it and their temperature reduced, maybe by 150 degrees. The feed water is passed through the economizer, going in at maybe 80 degrees and out at 200. THE MAXIM BOILER INCLUDES AS ONE OF ITS PARTS AN ECONOMIZER, and we have cases where the owners report the flue gases reduced to below 300 degrees.

THE ALISON ECONOMIZER IS ARRANGED AS PART OF THE MAXIM BOILER. It is the most effective economizer made. It makes the Maxim Boiler more economical than any other.

Report of test of two 250 H. P. Maxim Water Tube Boilers at works of the Keystone Watch Case Co., Philadelphia:

Average Temp. Feed Water, 62.5 degrees Fahr.

Average Temp. of Steam, 357 degree Fahr.

Average Temp. Escaping Gases, 312 degrees Fahr. Highest, 370 degrees, Lowest, 280 degrees.

Fuel, No. 2 Buckwheat or Rice Anthracite.

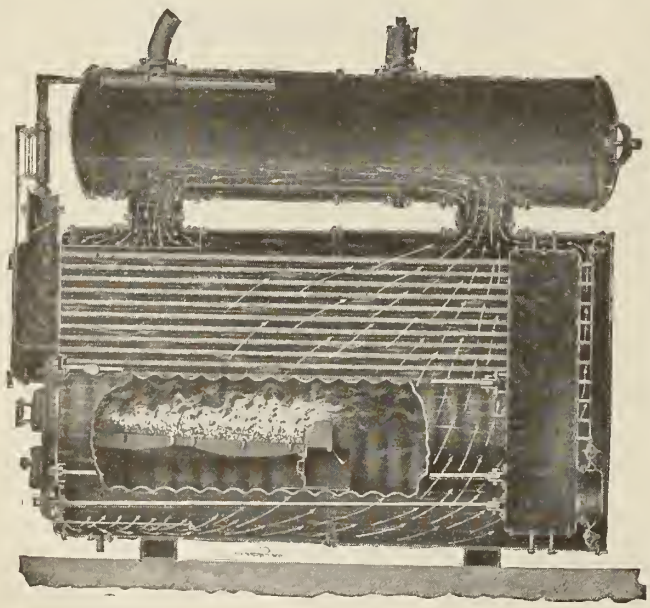
Quality of Steam, 99.5 per cent. dry.

EQUIVALENT WATER ACTUALLY EVAPORATED FROM AND AT 212 DEGREES PER POUND OF COMBUSTIBLE, 12.177 LBS.

The above test was made by the owners of the plant.

Maxim Tubes do not work loose, and Maxim Boilers make better use of the fuel than is possible with other boilers. MAXIM BOILERS ARE ECONOMICAL ALL THE TIME.

Ogilvy Engineering Company, Bank of Ottawa Building, **Montreal**



ROBB-BRADY SCOTCH BOILER

This new type solves the circulation problem. The water beneath the furnaces is constantly compelled to flow upward to the rear by the downflowing feed water which comes through the front neck, as shown.

The Robb-Brady Boiler has a cylindrical combustion chamber — engineers know what that means — no flat top, no crown bar or girder stays.

The large body of water in steam drum, neck, and shell maintains practically the same temperature throughout the boiler, preventing unequal expansion.

Ask for Bulletin No. 3.

ROBB ENGINEERING COMPANY LIMITED

SOUTH FRAMINGHAM, MASS. — AMHERST, N.S., CANADA

DISTRICT OFFICES:

Canadian Express Building, Montreal, R. W. Robb, Manager
Traders Bank Building, Toronto. - - Wm. McKay, "
Union Bank Building, Winnipeg, - - W. F. Porter, "
Grain Exchange Building, Calgary. - J. F. Porter, "

Sole Canadian Agents for C. A. Parsons & Co., Turbines, Turbo-Electric Generators, Turbo-Pumps, Blowers, Compressors, Etc.

39-14

Astonishing Reductions In Fuel Bills

effected by ordinary pipe coverings when placed on bare pipes are not as remarkable as the reductions J-M Asbesto-Sponge Felted Pipe Covering makes in fuel bills when placed on pipes previously insulated with ordinary covering. Repeated tests prove that J-M Asbesto-Sponge Felted Pipe Covering will save about 26% more coal than any ordinary covering. It will carry steam over a mile with practically no loss. The secret lies in the fact that

J-M Asbesto-Sponge Felted Pipe Covering

contains more dead air cells than any other covering.

Vibration or rough usage will not crack, break or cause J-M Asbesto-Sponge Felted Pipe Covering to crumble or lose its insulating efficiency. It retains its superior efficiency indefinitely, because made from many layers of a thin felt composed of best quality Asbestos Fibre and fine particles of granulated sponge.

To use J-M Asbesto-Sponge Felted is an investment, not an expense.

Write our nearest Branch for Sample and Catalogue No. 100.

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED

Manufacturers of Asbestos and Magnesia Products

TRADE ASBESTOS MARK

Asbestos Roofings, Packings, Electrical Supplies, Etc.

TORONTO MONTREAL WINNIPEG VANCOUVER

FLEXIBLE INTERLOCKING METAL HOSE

For Conveying Steam, Air, Gas, Etc.

This metal hose is made in either steel or copper and is just as light and flexible as rubber.

It will not kink, burn out or rot, and will give real service under all conditions.

Its lasting qualities are many times greater than those of rubber and there is practically no cost of maintenance.

Our prices are right. Get our circulars NOW.

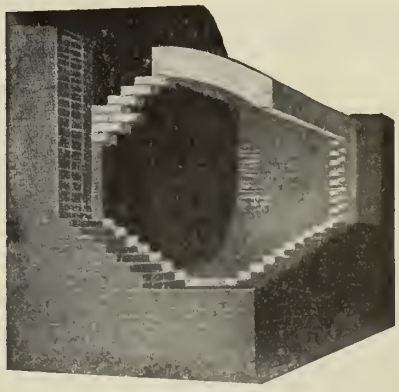
The Metallschlauch-Syndikat

PFORZHEIM, BADEN - GERMANY

F. J. SCHUCH

19 Jarvis St. - Toronto, Canada

(Canadian Agent)



Boiler Back Arch in One Block

Self Supporting, No Irons to Warp, No Exposure of Shell Above Waterline. A Whole Setting Lined Throughout With the Turner & Tupper's Plastic Fire Lining will be Gas and Air Tight. This Plastic Lining Material comes in bulk, in barrels, moist, ready to use.

Try out a barrel for patching.

The Turner & Tupper Co.

58 Peter St.

TORONTO ONTARIO

The advertiser would like to know where you saw his advertisement—tell him.

THE MURPHY AUTOMATIC SMOKELESS FURNACE

In last month's issue of "Power House" we listed nine **well-known Canadian firms** using **MURPHY AUTOMATIC SMOKELESS FURNACES**; nine years' experience and down to one year, showing **13 repeat orders.**

In Toronto we have in process of installation:

5 Furnaces *Toronto University* .....2000 H.P.
(This is a Central Light, Heat and Power plant.)
4 Furnaces *Toronto General Hospital* .....1644 H.P.
3 Furnaces *Toronto Carpet Mfg. Co.* ..... 425 H.P.
(This is a second contract.)
3 Furnaces *C. P. R. Office Bldg.* ..... 450 H.P.

The Fall of 1907 we installed 3 furnaces with water-tube boilers—each 250 H.P.—in the plant of the **Canadian Locomotive Works, Ltd.**, Kingston, Ont. Oct. 1910, 1 furnace, with like boiler unit as above. We now have in process of construction **two additional furnaces**—to be installed with boilers 333 H.P. each.

"THERE MUST BE A REASON!"

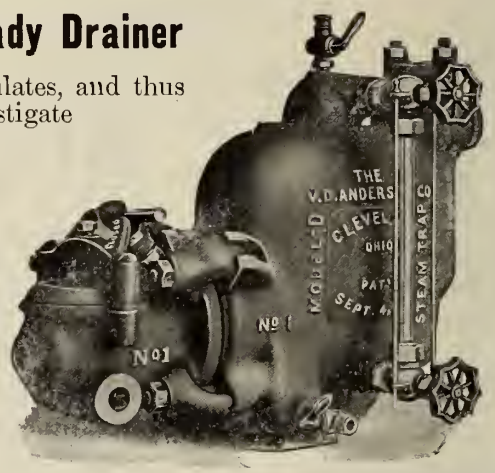
For printed matter address

MURPHY IRON WORKS, DETROIT, MICH. BUFFALO, N. Y.

If you want a Continuous, Reliable and Steady Drainer

which will dispose of the condensation as fast as it accumulates, and thus maintain a uniform temperature in your heating system, investigate

The Anderson Model "D" Steam Trap



The Anderson Model "D" does all this without reducing the pressure or permitting live steam to escape.

The trap is so constructed that you can change the valve and seat from high to low pressure or vice versa in five minutes without disturbing or unscrewing a single joint or pipe connection.

All parts are interchangeable, being machined to solid gauges, thus ensuring absolute accuracy.

A removable perforated strainer is part of the equipment, thus preventing pieces of scale, packing lead, etc., from entering the trap.

Every trap is tested and inspected under boiler pressure by experts before leaving factory. Every Anderson Model "D" is guaranteed.

Write for descriptive booklet.

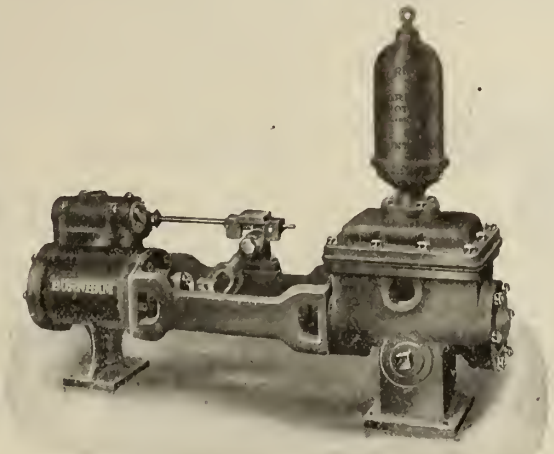
THE V. D. ANDERSON CO., West 96th St., Cleveland, Ohio

The advertiser would like to know where you saw his advertisement—tell him.

BURNHAM STEAM PUMP

Of the thousands of steam pumps installed every year, a large percentage of them bear the name of "Burnham," the **Steam Pump** endorsed by leading Architects, Consulting Engineers and Heating Contractors as the best, simplest and most economical pump on the market.

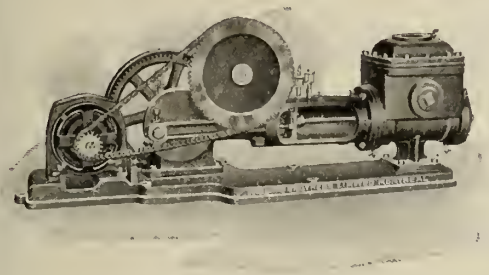
If you want a pump for handling hot water, use the "Burnham."



Burnham Boiler Feed Pump.

Thousands of Burnham pumps are in operation in connection with **Vacuum Heating Systems**; they are specially adapted for this service. Standard Burnham Boiler Feed Pumps and Burnham Vacuum Pumps are kept in stock and can be shipped promptly.

Ask for Catalogue "P."

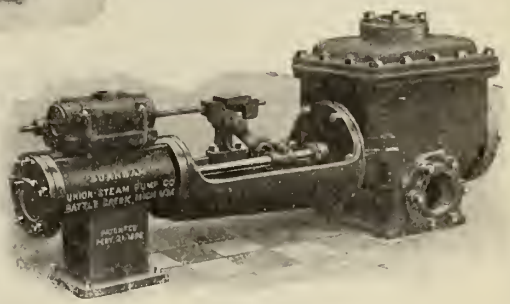


Union Electrically Driven Vacuum Pump.

Darling Brothers,
LIMITED

15 Ottawa St., Montreal.

Toronto, Winnipeg and St. John.



Burnham Vacuum Pump.

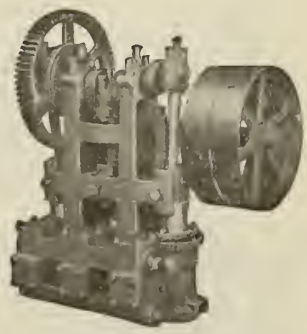
Deming Power Pumps

Made in Many Sizes

For all Pumping Conditions

Automatic Sprinkler System Pumps.
Boiler Feed Pumps.
Combination Water and Air Pumps.
Deep Well Working Heads.
Electric Driven Triplex Pumps.
Gas Engine Driven Pumps.
Paper Makers' Pumps.
Railway Water Supply Pumps.
Tank Pumps for light, medium or heavy service.
Waterworks Pumps.

and including many other others. The entire line is shown in our catalogue "H."



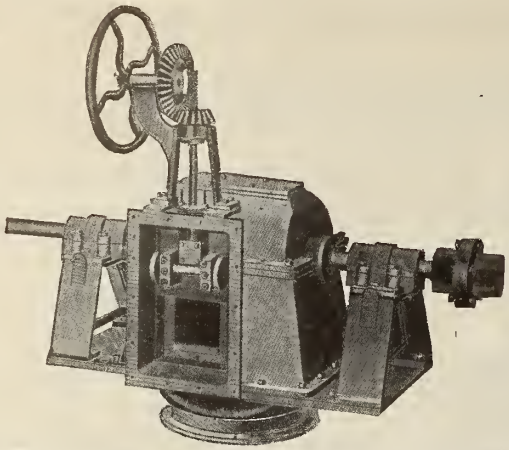
Deming General Service Triplex Power Pump for operation by belt. Requires but little power for operation.

The Deming Company

SALEM - - OHIO, U.S.A.

HAND AND POWER PUMPS OF ALL KINDS

Agencies—Henion & Hubbell, Chicago, Ill.: Darling Bros., Montreal, P.Q., Can.: Morgan Engineering Co., Seattle, Wash.: Neal Co., Buffalo, N.Y.



Little Giant Water Turbine

Self-contained Unit

Mounted on vertical or horizontal shafts. Gate consists of single casting, and is trouble proof. Adapted for all heads. Highest efficiency guaranteed.

Write for Catalog. Prices will Interest You.

J. C. WILSON & CO.

Founders and Machinists. GLENORA, ONT.

Eugene F. Phillips Electrical Works, Limited

MONTREAL CANADA

Bare and Insulated Electric Wire

Electric Light Line Wire. Incandescent or Flexible Cords.

Railway Feeder and Trolley Wire

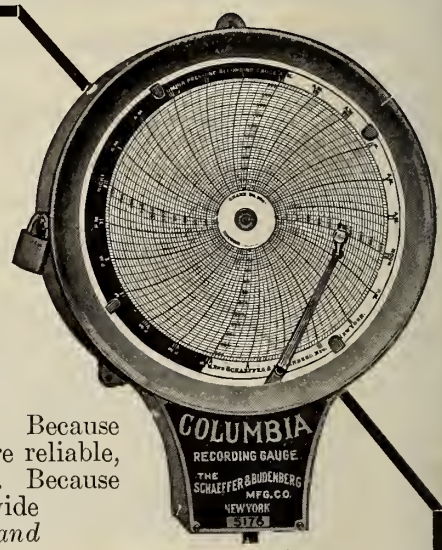
Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.

HALIFAX TORONTO WINNIPEG VANCOUVER

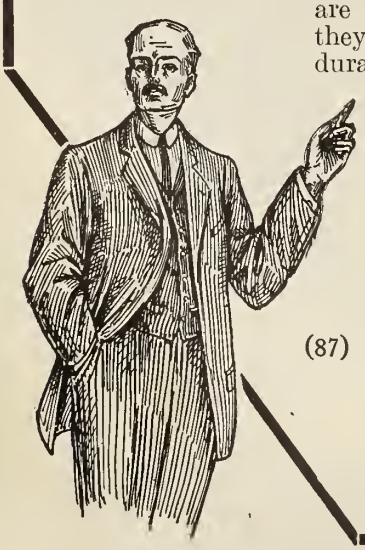
That Gauge Gives Accurate Records

Accurate records of pressure or vacuum can be obtained only from accurate Recording Gauges—naturally. And accurate records are the only kind that are of any value—that's certain. That's why

"Columbia" Recording Gauges



Made for any range of pressure or vacuum



are so popular and becoming more so every day. Because they *are* accurate and *stay* accurate. Because they are reliable, durable and superior in mechanical detail to all others. Because their charts are uniformly graduated, have wide effective working range and have the *night and day border.*

Still we don't ask you to believe this. Prove it for yourself. Every "Columbia" that leaves our shop is fully *guaranteed* and shipped on *approval,* which means should it not come up to your expectations in every respect, send it back—there is no expense to you.

(87)

Send for pamphlet W 105 without delay.

The Schaeffer & Budenberg Mfg. Co.

Chicago **Brooklyn, N.Y.** Pittsburgh

The advertiser would like to know where you saw his advertisement—tell him.

Power House Equipment

If you want to Buy, Sell or Exchange

CONSULT US ON

POWER HOUSE APPARATUS

Air Compressors
Alternating Current Generators, belted
Alternating Current Motors
Arc Dynamos
Arc Lamps
Boilers
Booster Sets
Condensers
Direct-Connected Units
both alternating and direct current
Direct Current Generators, belted
Direct Current Motors
Electrical Instruments
Engines
Feed Water Heaters
Hoisting Equipment
Motor Generator Sets
Pumps
Rotary Converters
Switchboards
Transformers
Turbines, both steam and water.

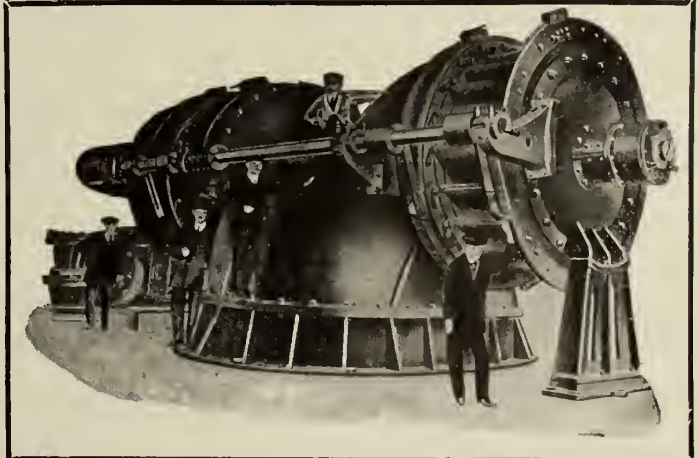
WE ARE THE MEN BETWEEN.

Railway Equipment Company of Toronto, Limited
1240-1250 Dundas Street, TORONTO, ONT.
Phone Junction 1247

WATER TURBINES
AND
GOVERNORS

All Sizes

Maximum Efficiency



All Heads

Ideal Control

ASK FOR PARTICULARS FROM
THE CANADIAN BOVING CO., LTD.
164 BAY STREET, TORONTO.
Branch Office for British Columbia, 427 Seymour St., Vancouver

The advertiser would like to know where you saw his advertisement—tell him.

Record Breaking Crops Bring Enormous Increase in Buying Power

Crops this year will be the third largest in the history of the country—30% greater than last year. Leading financiers estimate that the buying power of the country will be increased by at least $600,000,000.

Present indications are that within 60 to 90 days factories and mills of all kinds will be laboring under the rush conditions—is **your** plant ready for the **strain?**

DEARBORN SERVICE

The tidal wave of orders which seems to be at hand will find many plants without adequate power, and not time for increasing the power equipment. It will be necessary to realize the maximum power out of present equipment. This will necessitate **clean boiler plates** and **flues,** and the way to insure them is to have your boiler feed water analyzed—free of cost—by us, and then use the scientific water treatment which we prescribe.

Shut-downs due to boiler failures **must .not occur** when the big rush comes—now is the time to guard against this unnecessary expense and the loss of output. Send us gallon sample of your boiler feed water and we will make analysis and submit our recommendations for your consideration.

Dearborn Drug & Chemical Works

General Offices, Laboratory and Works, Chicago

General Eastern Offices—299 Broadway, New York. Buffalo Office—302 Morgan Building, J. N. Gregory, Mgr.

Would you like to Spend your Sundays at Home?

Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

YOU can reduce the labor and expense of boiler cleaning and cut down your consumption of fuel by using

McCOLL'S Special Boiler Compounds

or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

WRITE FOR PARTICULARS TO

McCOLL BROS. & COMPANY

Montreal, Toronto, Winnipeg or Vancouver

The advertiser would like to know where you saw his advertisement—tell him.

ENORMOUS SAVINGS
RESULT FROM THE USE OF

BOILER ENAMEL

For only one-sixteenth inch of scale in your boiler you are consuming 9 per cent. to 12 per cent. more fuel than necessary. STOP IT!

Only a little of **"Eclipse" Boiler Enamel** used constantly in your feed water will eradicate this expense. You will be so well satisfied with the results that the small cost of "Eclipse" will hardly be noticed.

"Eclipse" Boiler Enamel, being made of tropical plants, contains no substances that will injure metal.

It **prevents pitting, corrosion, foaming and many other boiler troubles** due to impurities in the feed water.

"Eclipse" removes old scale quickly and works equally well in any class of feed water.

Ask us for testimonials—we have many of them from well known firms.

Write for full particulars to-day.

W. W. CARRUTHERS

450 Edmonton Street, WINNIPEG, MAN.

Sales Agent for Ontario—M. McEACHERN, 131 Montrose Ave., TORONTO

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

W. A. CROCKETT

Executive Secretary

MT. HAMILTON, - - ONTARIO

WALKER'S ELECTRIC BOILER COMPOUND

SAVES

Fuel and Boilers

One-sixteenth of an inch of scale in your boiler will increase your fuel bills from 15 to 25 per cent. This has been proved through experience. Many plants are losing money and they are not aware of it. It pays to keep a close watch on the boilers. Examine yours at once; perhaps SCALE is causing those outrageous fuel bills.

We guarantee this compound to rid your boilers of all scale and prevent pitting, corrosion or other boiler troubles due to impure feed water, without the slightest injury to tubes or fittings.

Send us a sample of feed water for analysis, and get our prices.

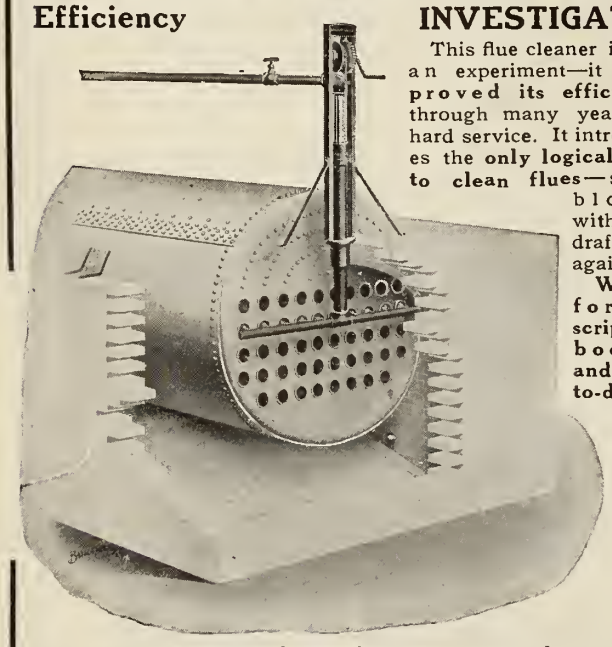
DO IT NOW!

The Electric Boiler Compound COMPANY, LIMITED

Guelph, - - Ontario

'THE HENRY' STEAM FLUE CLEANER

Saves Fuel, Saves Labor, Increases Boiler Efficiency



INVESTIGATE

This flue cleaner is not an experiment—it has proved its efficiency through many years of hard service. It introduces the only logical way to clean flues—steam blows with the draft--not against it. Write for descriptive booklet and price to-day.

Let us send one for your approval

THE STEAM APPLIANCE CO.

MILWAUKEE, WISCONSIN.

Western Agent: CANADA SALES CO. Donalda Bldg. Winnipeg.

Eastern Agent: ENGINEERS REPRESENTATIVE CO. 201 Board of Trade Bldg. Montreal.

The Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

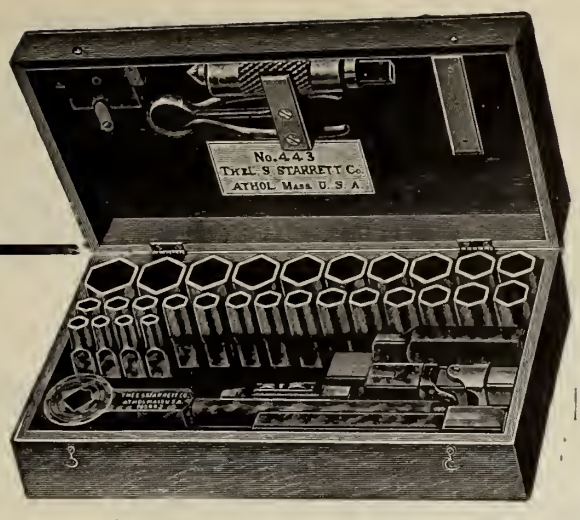
Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars and a Trial Trap.

Canadian Morehead Mfg. Co.

WOODSTOCK, ONT.

The advertiser would like to know where you saw his advertisement—tell him.



You're never cornered with a

Starrett Patent Ratchet Wrench

It will turn any standard nut or bolt in all sorts of difficult places—places where the ordinary monkey wrench is useless. The ratchet permits rapid action with only a short arc swing. The extension reaches into otherwise inaccessible places. The drilling attachment furnished with the wrench takes any twist drill from ⅛ in. to ½ in. A reversible screw driver makes it handy for turning screws of various sizes, too. Send for catalogue No. 19 CD, and see the whole Starrett line of fine tools. It's worth while.

THE L. S. STARRETT CO. : Athol, Mass.

42-59

THE
CANADIAN CASUALTY
AND
BOILER INSURANCE
COMPANY

ATTENTION:

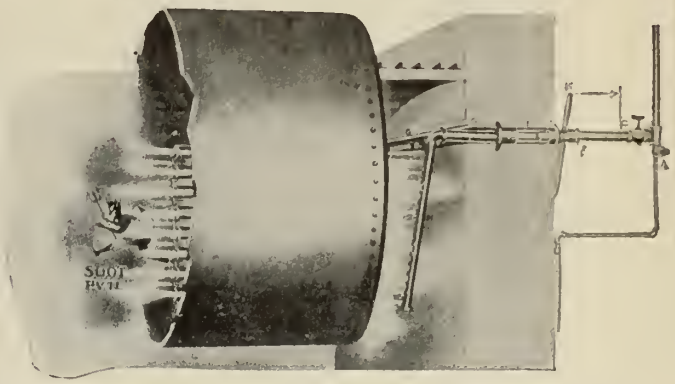
In what condition have you left your heating boiler? we would like the privilege to inspect it, and report to you what has to be done before the next heating season.

CONTINENTAL LIFE BUILDING
TORONTO

J. O. B. Latour, Chief Engineer.
John J. Durance, Manager.

Phone Main 6941

MORE STEAM



The Vulcan Cleaning a Return Tubular Boiler

LESS COAL

KEEP THE SOOT OUT OF
THE BOILERS WITH THE

VULCAN SOOT CLEANER

You'll get more steam and you'll save 5 to 10% on your coal hill.

The difference between a clean heating surface in your boiler and a dirty one, is often the difference between dividend and deficit. It is the daily operating cost of a boiler that counts. If the boiler tubes are coated with soot you face a drop in capacity and a **big loss in efficiency.**

The profit lost through a dirty boiler would pay for a Vulcan Soot Cleaner many times over. The Vulcan will produce a saving for you the same as it does for others. It is the **modern** way of handling the soot problem.

Soot defies removal by hand blowing. The Vulcan scours the tubes as clean as gun barrels—removes **all** soot in a few minutes—no shut-downs—no time waste—no dirt—no trouble—no air leakage—nothing but complete satisfaction and results.

We send the cleaner on 30 days' free trial—return it if you don't like it. We won't get "sore" nor try to force the cleaner on you. **IT'S UP TO YOU.**

Return the coupon and get our trial proposition and a free copy of "Economical Steam Production," a complete and pointed discussion on soot and how to get rid of it.

Cleaning Water Tube Boilers is also OUR SPECIALTY

Vulcan Tube Cleaning Systems
LIMITED

42 Craig St. West, MONTREAL.

----------SIGN, TEAR OUT AND MAIL----------

Power House, June 12. *Date*.....

Vulcan Tube Cleaning Systems, Limited,
42 Craig St. West, Montreal.

Please send me without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.
(It is important that following information be given in full.)

Water Tube Boilers. Number.....Type.....Pressure.....
Horsepower.....No. Tubes High (except on Stirling boiler .....
Any Superheaters.....Width of alley space at side.....
Tubular Boilers. Number.....Horizontal or vertical.....
Name.....
Address.....

The advertiser would like to know where you saw his advertisement—tell him.

WELD YOUR BREAKS

DON'T WASTE VALUABLE TIME AND LOSE MONEY BY WAITING FOR RENEWAL PARTS OF YOUR MACHINERY, BUT TELEPHONE OR TELEGRAPH US AT ONCE, AND OUR EMERGENCY WELDING REPAIR OUTFIT AND OPERATORS WILL BE ON THE JOB WITH THE SPEED OF A FIRE BRIGADE.

AUTOGENOUS WELDING AND CUTTING

(OXY-ACETYLENE PROCESS)

OUR ONE SPECIALTY

For which we are equipped with the most modern plant and expert operators that money can buy. No work too large or too difficult for us.

If the broken part is a small one, express it to us—if a heavy one, we will express ourselves to you.

Our Long Distance Telephone Numbers are

DAY CALLS—Adelaide 198. NIGHTS and SUNDAYS—Hillcrest 431.

THE FRANCO-CANADIAN WELDING CO.

331 YONGE STREET TORONTO

Get our Name and Address firmly fixed in your mind.

"We must hope all things, believe all things, endure all things rather than lose that most precious of all earthly possessions--a trusty friend."--*Charles Kingsley*

THE ENGINEER must have a babbitt metal upon which absolute reliance can be placed. That is why he specifies

Harris Heavy Pressure

THE BABBITT METAL WITHOUT A FAULT

It is doubly copper hardened.
It is guaranteed not to crack or squeeze out.
It positively eliminates friction.
It runs cool at any speed.

Harris Heavy Pressure

is the Engineer's Trusty Friend

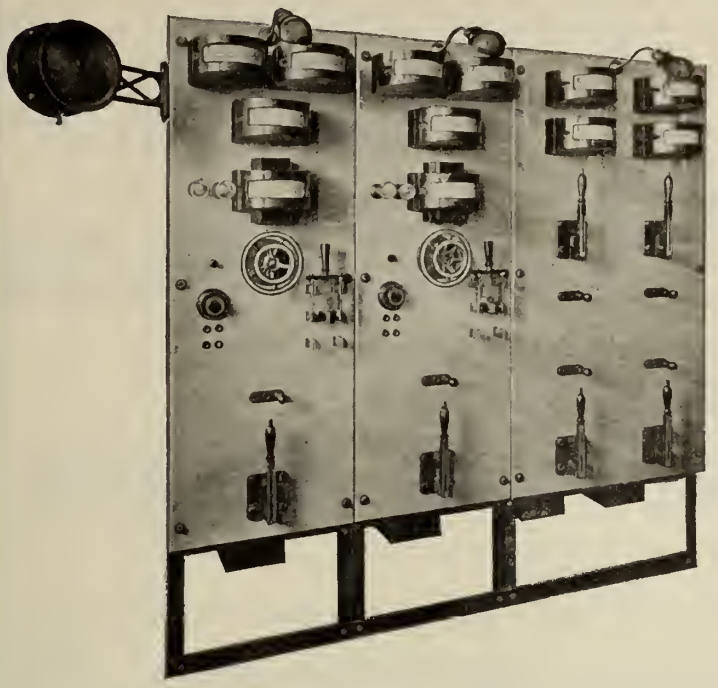
OUR GUARANTEE IS BACK OF EVERY POUND

WRITE FOR PRICES

The Canada Metal Co., Limited

TORONTO MONTREAL WINNIPEG

The advertiser would like to know where you saw his advertisement—tell him.



NORTHERN ELECTRIC SWITCHBOARDS

Only the highest grade Material and Workmanship enter into the design and construction of Northern Electric Switchboards.

Our facilities for making prompt shipments are of the best.

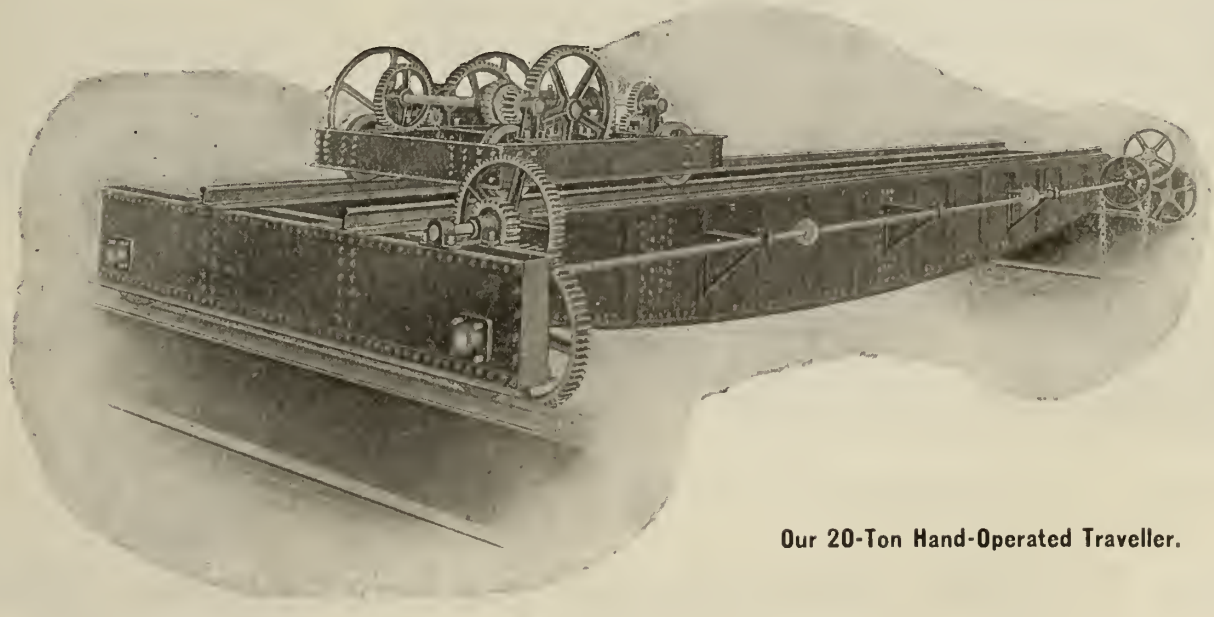
Send us your specifications and get our attractive quotation.

THE Northern Electric AND MANUFACTURING CO. LIMITED

Manufacturer and Distributor of Telephone Apparatus, Electrical Supplies, and Fire Alarm Apparatus for every possible need.

Montreal Toronto, Winnipeg. Regina, Edmonton, Calgary, Vancouver.

ALL TYPES **CRANES** ALL SIZES



Our 20-Ton Hand-Operated Traveller.

We design and manufacture all kinds of lifting and hauling appliances. Our experience and advice will be found worth having; let us know the nature of your business and we shall be pleased to advise the best equipment for your purpose.

International Marine Signal Co., Limited, Ottawa, Ont.

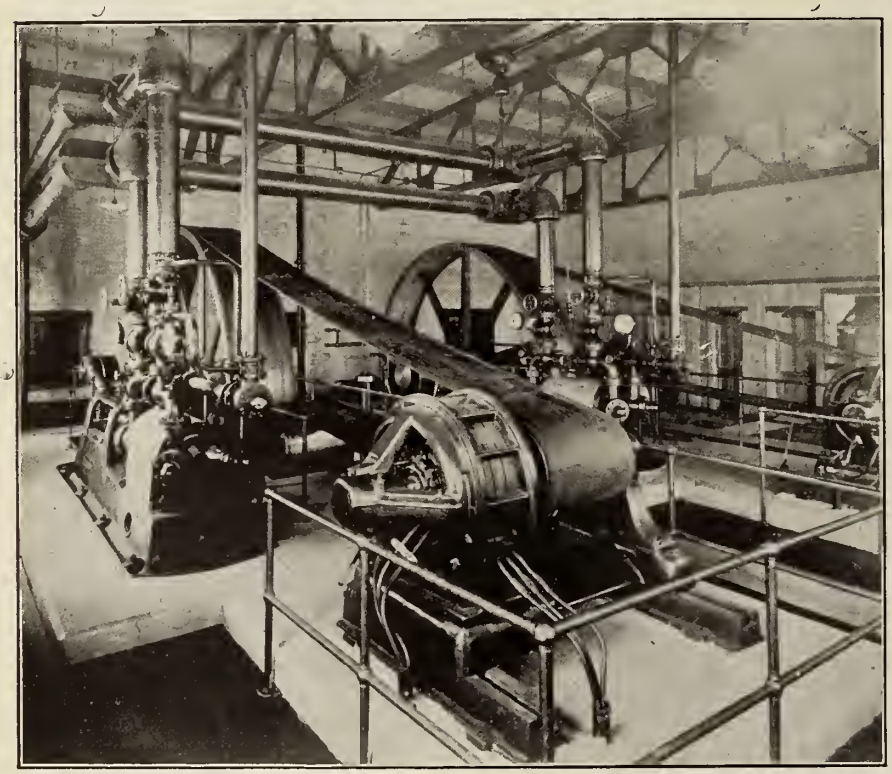
The advertiser would like to know where you saw his advertisement—tell him.

"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt Driven, Double Acting, Horizontal Ammonia Compressors Manufactured and Installed by us in Canada.

Recent Orders:—

C.P.R. VANCOUVER HOTEL
Vancouver, B. C.
MATTHEWS, LAING LTD.
Winnipeg, Man.
CARSON'S HYGIENIC DAIRY CO.
Winnipeg, Man.
ST. THOMAS PACKING CO.
St. Thomas, Ont.
MONTREAL GENERAL HOSPITAL
Montreal, P.Q.
OTTAWA UNIVERSITY
Ottawa, Ont.
WM. DAVIES CO.
Winnipeg, Man.
CANADIAN NATIONAL EXHIBITION
Toronto, Ont.
McGILL UNIVERSITY,
Montreal, P.Q.
G. T. P. FORT GARRY HOTEL
Winnipeg, Man.
C.P.R. ALGONQUIN HOTEL
St. Andrews, N. B.

AND MANY OTHERS.

The Linde Canadian Refrigeration Co., Limited

37 ST. PETER STREET, MONTREAL.

BRANCH OFFICES—Toronto, Imperial Building, Adelaide St.; Winnipeg, 909½ Main Street; Vancouver, Anderson & Miskin, Imperial Block, Seymour and Pender Streets; Edmonton, Walker & Barnes, 562 Second Street; Calgary, General Supplies Limited, 1233 2nd Street East.

The advertiser would like to know where you saw his advertisement—tell him.

TRADE
LINDE
MARK

Communicate with US

Before Placing Your next Order for

ICE-MAKING AND REFRIGERATING MACHINERY

The "**Linde**" **Machines** were invented and first built about 40 years ago by Professor Carl Linde. He was the first to construct these types of machines, and though **many imitations have sprung up since then,** none has ever come up to the **real Linde,** which to-day **is used all over the world,** giving perfect satisfaction wherever installed.

Government and municipal authorities, after investigating and testing the different systems of refrigeration have invariably placed their order for the **genuine** "**Linde**" systems.

8,200 Linde plants in operation.

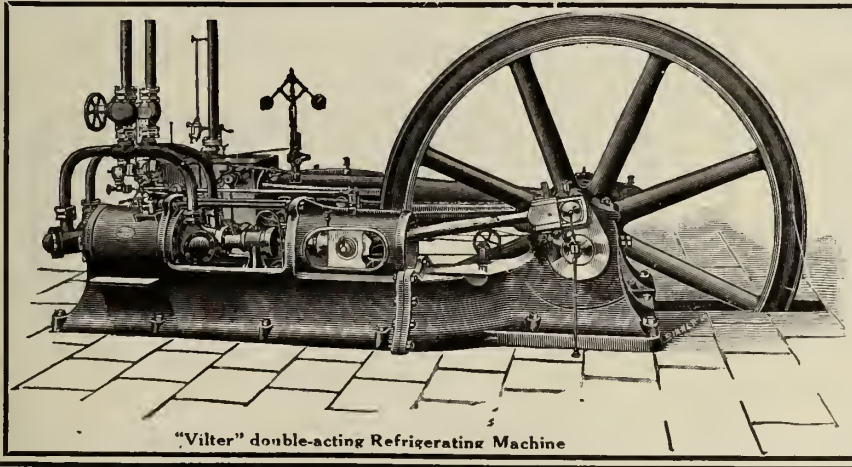
Write for catalogue; also for names of firms using this system.

Write them and get their verdict.

THE LINDE BRITISH REFRIGERATION CO., LIMITED

HEAD OFFICE, 35 Queen Victoria St., London, E.C.

628-9 Coristine Building **MONTREAL, P. Q.**



"Vilter" double-acting Refrigerating Machine

Established 1867

The VILTER MFG. CO.

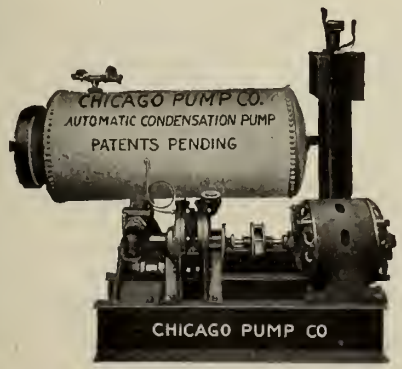
242 Becher St. Milwaukee, Wis.

BUILDERS OF HIGH-GRADE

CORLISS ENGINES
ICE AND REFRIGERATING MACHINERY

any size and for any purpose, complete line Ammonia Fittings, Condensers, Brine Coolers, etc.

Write for Catalogue and full Particulars



A GREAT SAVER

OUR

Automatic Electric Condensation Pump

Takes condensation water and air out of the heating system and allows the steam to circulate freely with lower boiler pressure. In this way it makes the heating uniform throughout the building and

SAVES FROM 20 to 50% COAL

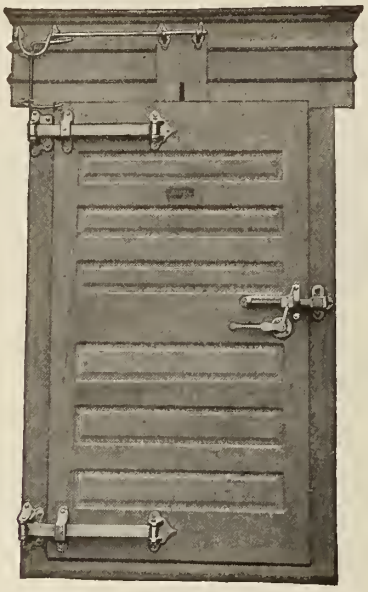
and much firing labor.

WRITE FOR CATALOGS.

CHICAGO PUMP CO., 904-910 W. Lake St., CHICAGO, ILL.

The advertiser would like to know where you saw his advertisement—tell him.

J. V. Jamison, President. T. B. South, Vice-President. J. V. Jamison, Jr., Treasurer.



This "Ad" is addressed to users of

Refrigerator Doors, Windows and Ice Chutes

in Canada

for Cold Storage, Meat, Fish, Dairy, Poultry, Fruit and Vegetable products.

We guarantee our Doors not to sag or stick in the frames.

Our Hardware weighs 60 lbs. to set.

We manufacture or sell nothing else.

Our entire time and forces are directed to this line.

We supply

Linde British Refrigeration Co.
Linde Canadian Refrigeration Co. of Canada.
Armour & Co., Chicago, Ill., U.S.
Swift & Co., Chicago, Ill., U.S.

with all they use. Our latest orders are to Swift & Co., for Toronto, Can., 30 Doors; Canadian Fish and Cold Storage Co., Prince Rupert, B.C., 110 Doors.

Send for Catalogue

Jones Cold Store Door Co.

HAGERSTOWN, MARYLAND, U.S.A.

Get More Service From Your Machinery!

NUMIDIAN CYLINDER OIL
VELOX ENGINE OIL
EVERY GALLON GUARANTEED

THESE OILS WILL HELP YOU!

If you are not using our **Numidian Cylinder Oil** or **Velox Engine Oil**, give them a trial. You will be surprised at the difference in the running of your machinery.

These high grade oils sell at a reasonable price—a price which will appeal to you.

Write for samples.

C. C. Snowdon

Wholesale

P.O. Box 1384. CALGARY, ALTA.

From Factory to Consumer

Dominion Babbitt Metals are more generally used where known than any other make in the market.

There is a reason for this—they are sold on merit—every pound fully guaranteed.

We specially commend to users of Babbitt Metal the following Dominion brands of Babbitt as representing the best formulae used in the Engineering World to-day:—

"Genuine" "Special Hard"
"Eagle Genuine" "Metallic Packing"
"Delta Genuine" "Beta Copperized"
"Copper Tough" "Maple Leaf"

Furthermore, these babbitt metals are not only of the most improved design, but **COST THE CONSUMER LESS MONEY** than other widely advertised babbitts.

Let us tell you about them, and submit you descriptive catalogue—invaluable to any Engineer.

Our Prices are named F.O.B. your Station.

The DOMINION METAL COMPANY

N. B. Prichard, Engineer and Manager

SHERBROOKE, P. Q.

SOME SAVING

They use 40 per cent. less oil.
They use a cheaper oil.
They use less metal.
They save cost of rebabbitting.

ALSO

It is cheaper and better than "Genuine" Babbitt.
It never runs hot.
It never cuts a shaft.
It never "breaks up."
It wears longer.
It stands the severe test on Rolls.
It is used on all of the Engine bearings.
It naturally absorbs less power.

Can Any Babbitt Do Better?
Can Any Other Do As Well?

MANISTEE FLOURING MILL COMPANY,
Manistee, Mich., April 30th, 1912.

Magnolia Metal Co., New York, N.Y.

Gentlemen:—

We wish to relate the experience which we have had with Magnolia Metal in the past years. Our oil supply has been reduced fully 40 per cent., and since using Magnolia Metal, we have not known what a hot box is, and are using a cheaper grade of oil. We have used a good many metals, including Genuine, and have found them to be either too hard, cutting the shaft, or too brittle, breaking up.

Magnolia Metal should be heated just hot enough to brown a white pine stick, keeping it thoroughly stirred before pouring. We use it in our rolls, a very severe test for babbitt, and on all the bearings in the engine. We do not use near as much babbitt as in former years.

Yours very truly,

MANISTEE FLOURING MILL CO.,
By ARTHUR WALT, Supt.

SPECIAL OFFER.

PRACTICAL ENGINEER POCKET BOOK: 700 pages, over 2000 subjects. Price 40c. post paid. We import these books, in large numbers, from England, as an advertising medium and give Engineers the benefit of low price. They are highly spoken of.
Address Montreal Office.

Sold by leading dealers everywhere, or by

Magnolia Metal Co.

Office and Factory:
225 St. Ambroise Street, Montreal

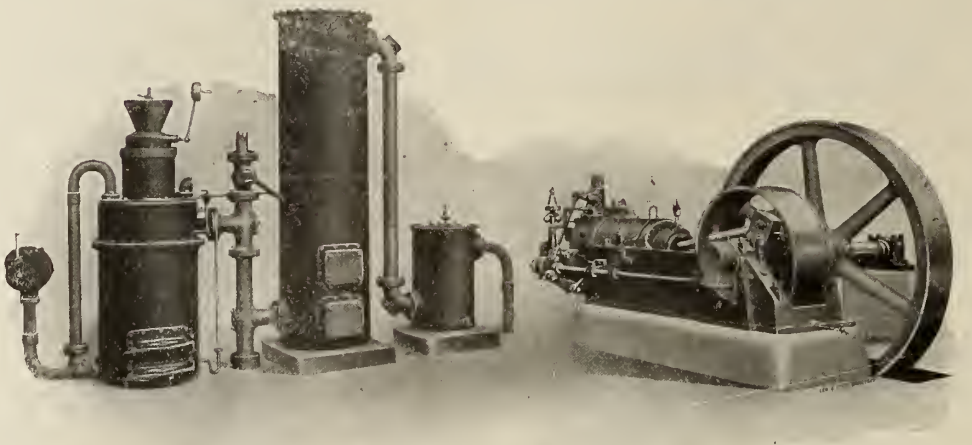
The advertiser would like to know where you saw his advertisement—tell him.

ESTABLISHED 1870.

JOHN ROBSON, (Shipley), Ltd.

SHIPLEY, Yorks, England.

Sole Makers of the **"Robson"** Oil Engine for working on Crude and Petroleum Oils.



Sole Makers of the **"Robson"** Engine for working on Towns and Suction Gas.

Photograph of Gas Engine and Suction Gas Producer Plant.

Suction Gas Producer Plants for working on Anthracite Coal, Coke or Charcoal.

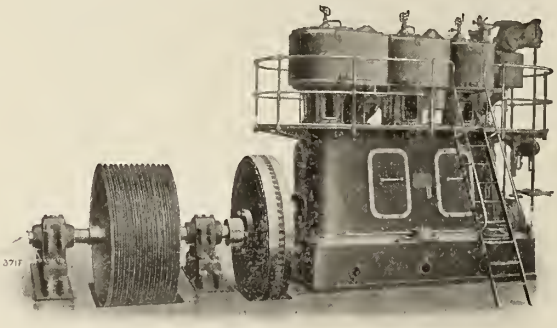
AGENTS WANTED. **WRITE FOR CATALOGUE.**

STEAM ENGINES

OF THE

BELLISS & MORCOM Vertical High Speed Type

Embody perfection of design and workmanship as evinced by their



Triple Expansion Engine Coupled for Rope Drive.

Simplicity
Durability
Quiet Running
Efficiency
Steady Running and Governing
Absence of Vibration, etc.

MANUFACTURED BY

Messrs. BELLISS & MORCOM, BIRMINGHAM, ENG.

AGENTS:

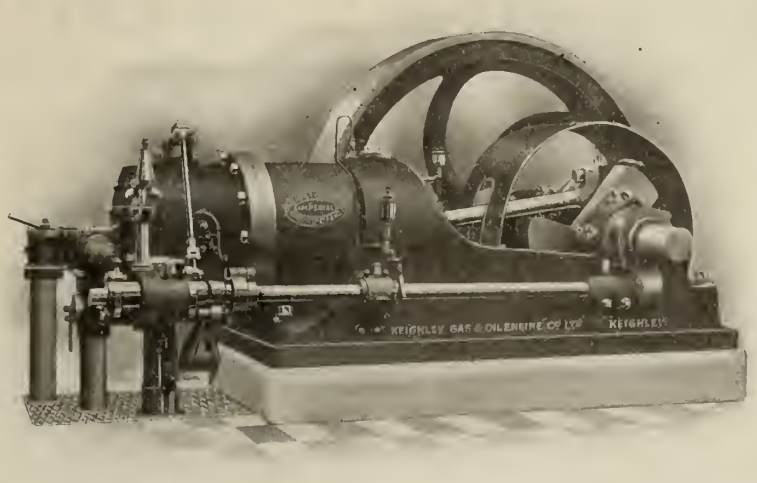
LAURIE & LAMB

BOARD OF TRADE BLDG. *ENGINEERS* MONTREAL.

The advertiser would like to know where you saw his advertisement—tell him.

"IMPERIAL"

IMPERIAL GAS ENGINES ARE USED IN THE OLD WORLD AND THE NEW



PROVED AND PRIZED IN BOTH

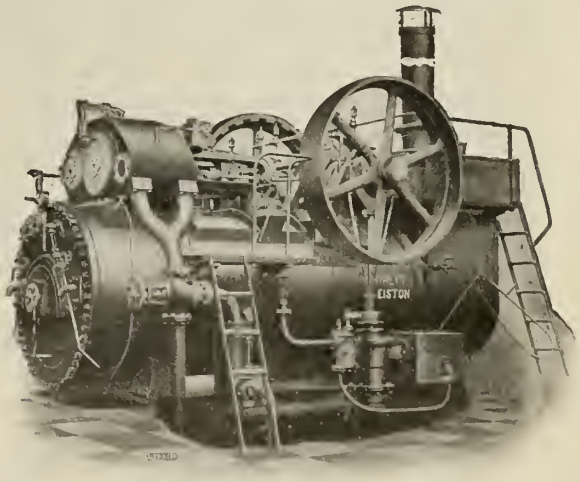
Invented and Manufactured by the
KEIGHLEY GAS & OIL ENGINE CO.
LIMITED
KEIGHLEY, - - - - - ENGLAND

Sole Selling Agents in CANADA
H. W. PETRIE, Ltd.
MACHINERY EXPERTS
TORONTO, - - - - - ONTARIO

CATALOG AND PRICES ON APPLICATION

LOCOMOBILES
Engine and Boiler Combined

Why not send for our booklet giving details of the wonderful performance of the Garrett Patent Superheated Semi-Stationary Engine. The cylinders are placed on top of the boiler and are jacketed by the live steam from the boiler. Moreover there are no pipe lines and no cylinder condensation losses. It is the most efficient engine made and is used for every power purpose.



The above engine with 536° of superheat ran at 95.5% efficiency, evaporated 8.91 lbs. of water per lb. of coal, and

USES ONLY 1.19 LBS. OF COAL PER B.H.P. PER HOUR

Send me circulars re your Semi-Stationary Engine.
NAME.....
STREET.....
CITY.....

CANADIAN P. J. MITCHELL COMPANY, Limited
ENGINEERS and CONTRACTORS, 30 St. Francois Xavier Street, MONTREAL, P.Q.

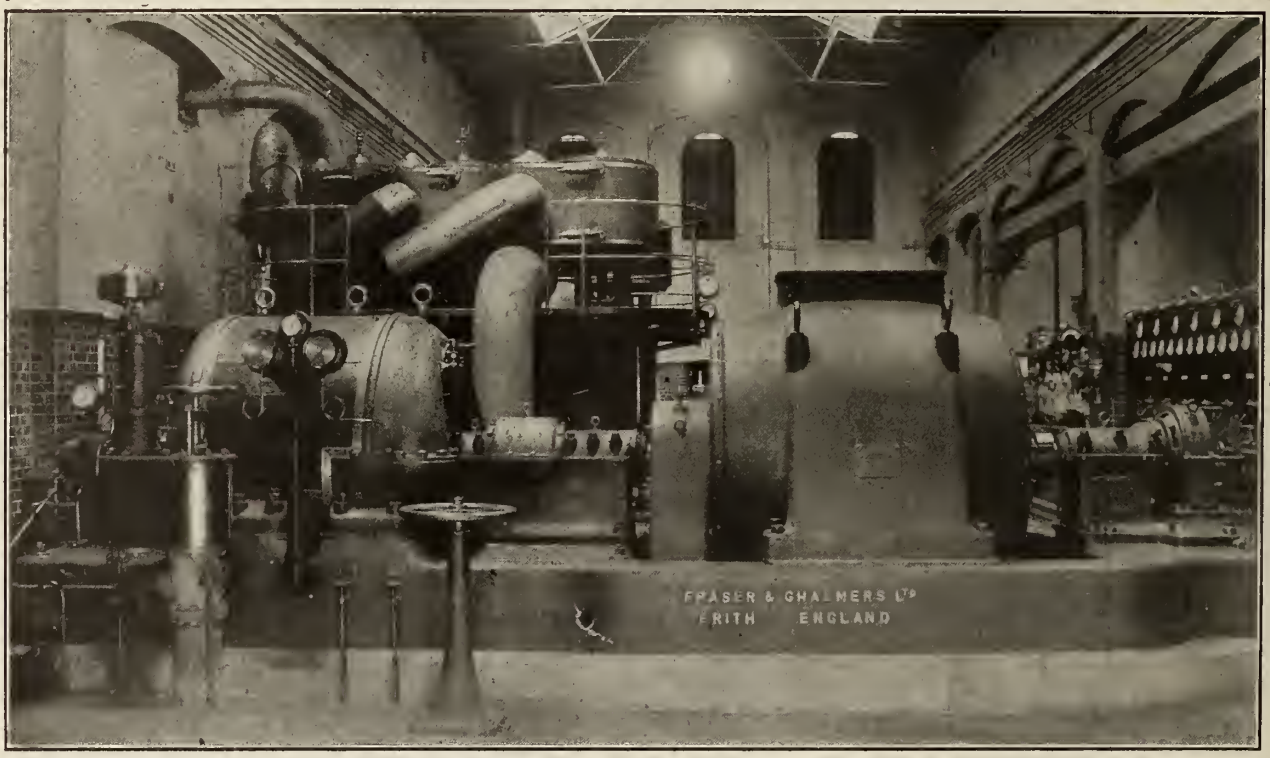
The advertiser would like to know where you saw his advertisement—tell him.

STEAM TURBINES

High Pressure Low Pressure Mixed Pressure

AND

Turbo-Blowers for Blast Furnaces or Converters



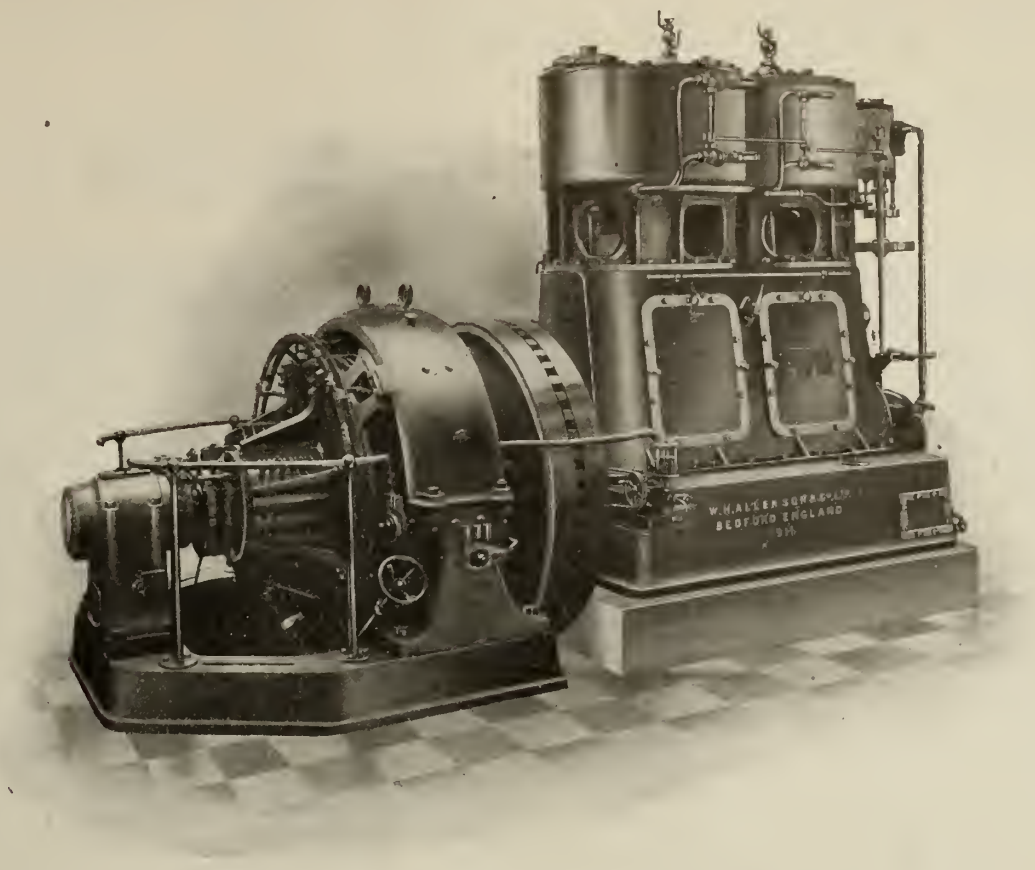
This 1000 k.w. Turbine, installed in an electric railway power station, replaced three compound condensing high speed engines and reduced the average water rate per killowatt hour from 32 to 18 pounds of steam. Load varies from 25% of full load to 60% overload.

Fraser & Chalmers

LIMITED

Canadian Office

4 Phillips Place - Montreal, P.Q.



INSTALLED AT THE POWER HOUSE TORONTO UNIVERSITY

The illustration represents a standard two crank, compound, enclosed type engine of 440 B.H.P., 400 R.P.M., direct connected to 300 Kilowatt, three wire, interpole, compound generator.

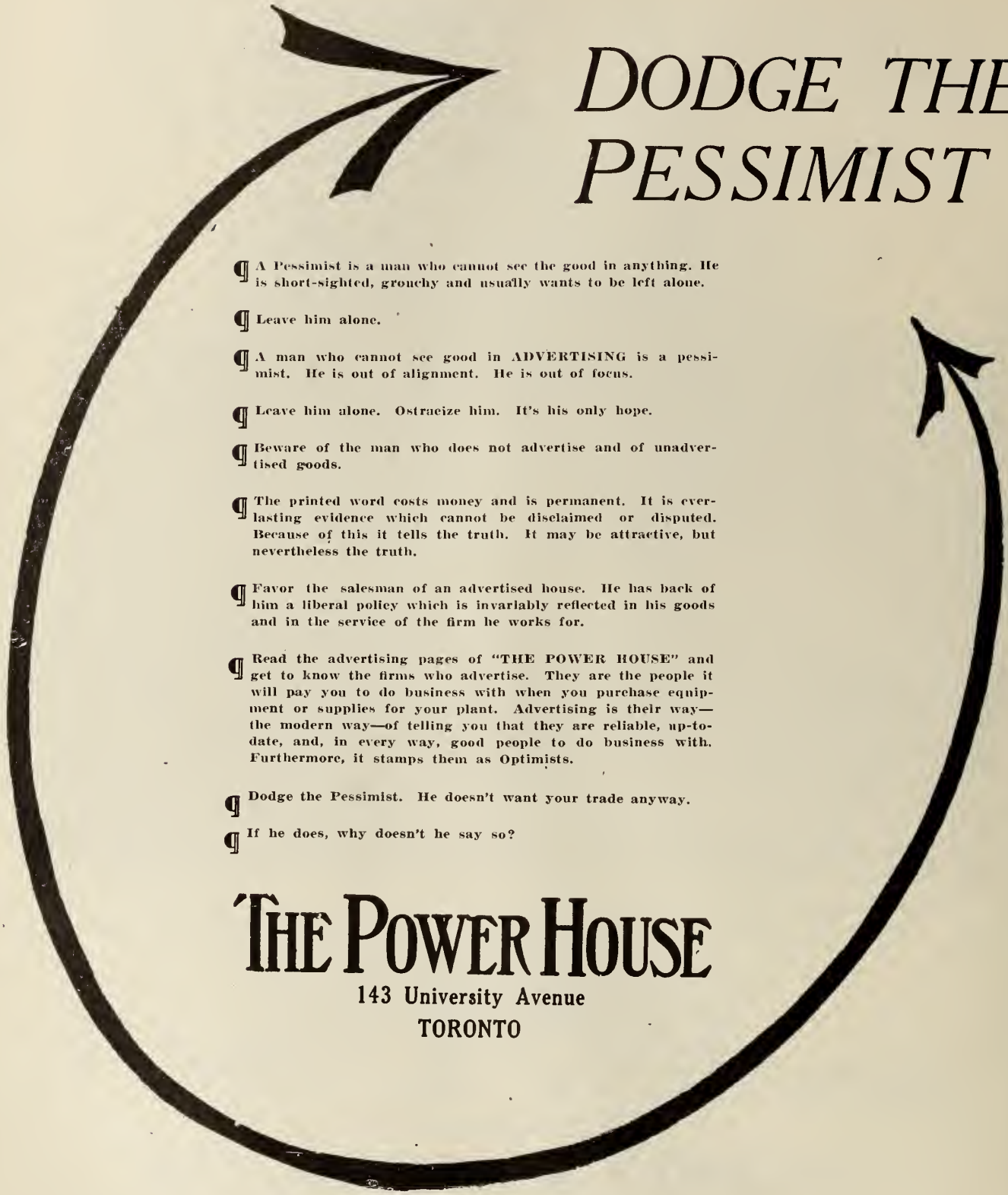
THE WHOLE UNIT WAS MANUFACTURED BY MESSRS. W. H. ALLEN SON & CO., BEDFORD, ENGLAND AND ERECTED BY MESSRS. CHAPMAN & WALKER.

CANADIAN REPRESENTATIVES:

CHAPMAN & WALKER, LTD.

69 Victoria Street, Toronto

Resident Engineer for Canada: A. LEO MIEVILLE, A.M. Can. Soc. C.E.



DODGE THE PESSIMIST

¶ A Pessimist is a man who cannot see the good in anything. He is short-sighted, grouchy and usually wants to be left alone.

¶ Leave him alone.

¶ A man who cannot see good in ADVERTISING is a pessimist. He is out of alignment. He is out of focus.

¶ Leave him alone. Ostracize him. It's his only hope.

¶ Beware of the man who does not advertise and of unadvertised goods.

¶ The printed word costs money and is permanent. It is everlasting evidence which cannot be disclaimed or disputed. Because of this it tells the truth. It may be attractive, but nevertheless the truth.

¶ Favor the salesman of an advertised house. He has back of him a liberal policy which is invariably reflected in his goods and in the service of the firm he works for.

¶ Read the advertising pages of "THE POWER HOUSE" and get to know the firms who advertise. They are the people it will pay you to do business with when you purchase equipment or supplies for your plant. Advertising is their way—the modern way—of telling you that they are reliable, up-to-date, and, in every way, good people to do business with. Furthermore, it stamps them as Optimists.

¶ Dodge the Pessimist. He doesn't want your trade anyway.

¶ If he does, why doesn't he say so?

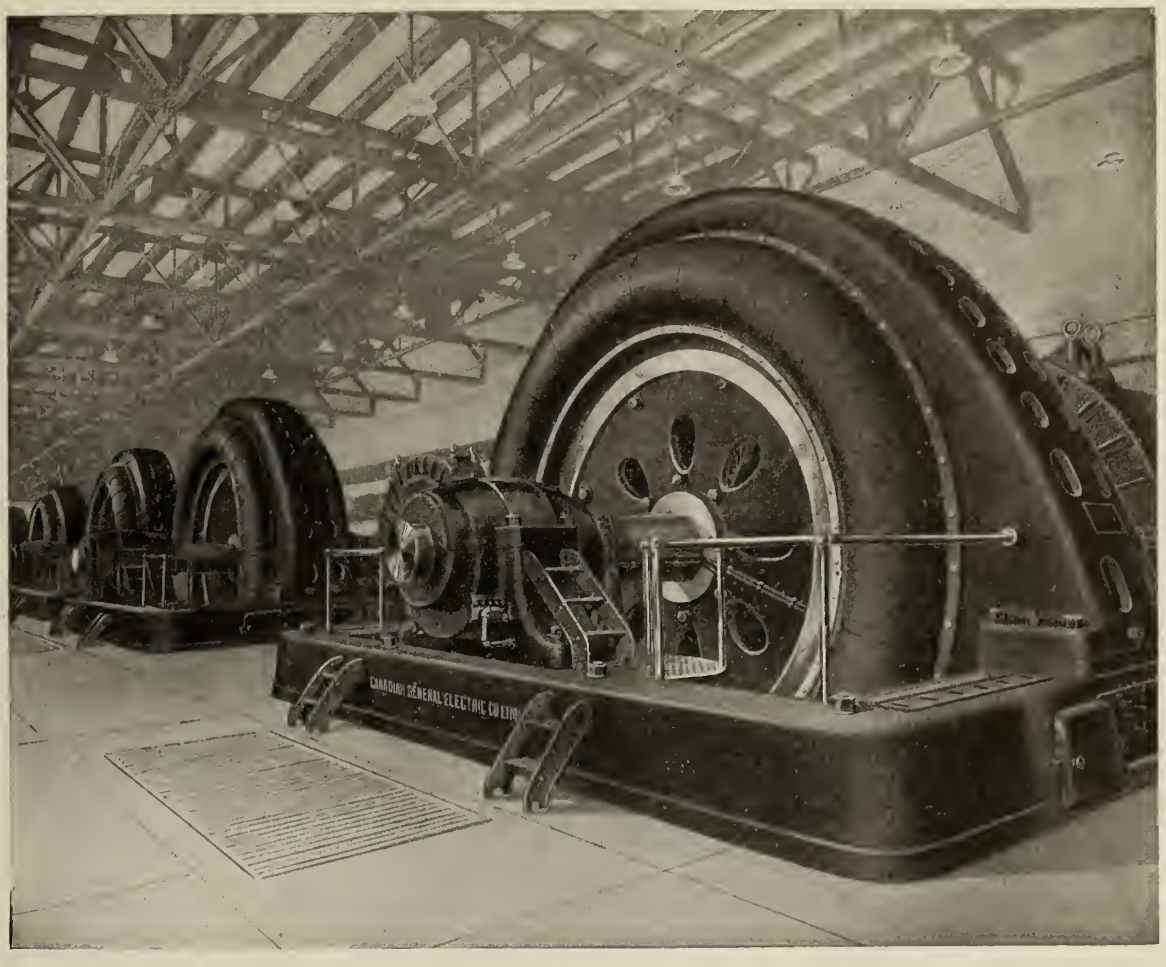
THE POWER HOUSE

143 University Avenue

TORONTO

Electrical Equipment for Power Houses

Alternating Current Direct Current
Any Standard Speed or Voltage



10,000 H.P. Generators installed in Power House, Ontario Power Co., Niagara Falls, Ont.

We are prepared to install complete Power House Equipment, Steel-work, Generators, Exciters, Switch-boards, Transformers, Boilers, Pumps, Feed Water Heaters, etc.

Let us figure on your specifications.

Canadian General Electric Co., Limited

Toronto, Montreal, Halifax, Ottawa, Cobalt, Porcupine, Winnipeg, Calgary, Nelson, Vancouver, Prince Rupert.

The advertiser would like to know where you saw his advertisement—tell him.

HEAVY DUTY GOLDIE CORLISS STEAM ENGINES

Nothing but the best quality of material is used in the construction of these Engines, this coupled with the fact that the most skilled Mechanics obtainable are employed, explains why they are to be found in the most modern and best equipped Power Plants in Canada.

Illustration shows the magnificent new Power House of the Grand Trunk Pacific Shops at Transcona, Man., in which we have recently installed five Heavy Duty Goldie Corliss Steam Engines and two Ideal High Speed Steam Engines.

ASK FOR A COPY OF OUR NEW CORLISS CATALOGUE.

The Goldie & McCulloch Co., Limited

GALT, - - ONTARIO, - - CANADA.

WESTERN BRANCH
248 McDermott Ave., Winnipeg, Man.

MARITIME PROVINCES
13-15 Dock St., St. John, N.B.

QUEBEC AGENTS
Ross & Greig, 412 St. James St., Montreal, Que.

BRITISH COLUMBIA AGENTS
Robt. Hamilton & Co., Vancouver, B.C.

The advertiser would like to know where you saw his advertisement—tell him.

Machine Firing at the Royal Liver Building, Liverpool, Eng.

By C. T. D.

The application of mechanical devices to the firing of steam boilers is making considerable and rapid progress, due to the fuller realization of the benefits derivable from automatic regulation of the fuel supply, its more perfect combustion and the reduction to a minimum of smoke emission. The present article deals with an installation in which the "Bennis" stoker is the feature of the boiler equipment.

ONE of the most necessary, if the least conspicuous parts of the new buildings of the Royal Liver Friendly Society, recently opened at Liverpool, England, by Lord Sheffield, is the boiler-house, a department that conduces very materially to the comfort and well-being of the occupants of the building. It is, of course, from the boiler-house, that the lighting, heating and the travel of lifts and hoists is controlled. Here, steam, the prime mover, is produced, on which depends the generating of the electric current required both for lighting and power purposes. Steam is also essential for heating the ten floors of the huge building. The Royal Liver Society was fortunate in securing as its consulting engineer, Capt. H. R. Sankey, R.E., M.Inst.C.E., and M.I.Mech.E., of Palace Chambers, Westminster.

Location of Boiler Room.

Space in the city of Liverpool being as precious as diamonds, and about as valuable, the boiler-house of the Royal Liver Building is situated below the street level, a distance of some 20 feet. One of the problems, therefore, connected with the building was the arrangement of the coal storage. It was, of course, necessary that the capacity of the storage should be sufficient for the demands made on it by the boilers, and that it should be so situated that its contents could be delivered with facility direct to the boilers. The latter are situated at right angles to the street, from which they stand back about 30 ft. The four large storage bunkers run the length of the boiler-house on the street side. From the bunkers a collecting conveyor is fitted and this is made of the standard "Bennis" U-link chain type, which consists of a chain working in a cast iron trough. Its action is that of drawing the coal from one point to another. The chain itself is composed of a series of U-shaped links of adequate tensile strength for the work they have to do. The distinctive features of this conveyor are:—

(1)—Simplicity in design, construction and operation, there being no complicated parts to get out of order.

(2)—Flexibility in application.

(3)—The small amount of power necessary to the drive.

(4)—The ease with which worn parts can be replaced without the aid of expensive skilled labor.

Coal is delivered to the end of this conveyor into an inclined conveyor, which in its turn delivers into a distributing conveyor running immediately above the boiler fronts. The inclined conveyor and the distributing conveyor are similar to the collecting conveyor, and travel at the speed of 40 feet per minute. Here it may be said that the conveyors work so quietly that it is impossible for anyone in the next room to tell when they are in operation. The building is of ferro-concrete, and one condition of the contract was that no noise whatever should be made by the coal-handling plant, as the steel rods used in the construction of the ferro-concrete would act as conveyors of sound to the various parts of the building, and so disturb the offices. Silence in the working of the boiler-house plant is therefore essential. This condition has been satisfactorily fulfilled, so that when the plant is working at full pressure, not a sound can be heard from the boiler-house. From the distributing conveyor there is communication by shoots with the stoker hoppers. The shoots are provided with cut-off slides. The conveyors are supported by a system of girders, as shown on the drawing.

THE ROYAL LIVER SOCIETY BUILDING. LIVERPOOL.

Boilers and Stoking Requirements.

The four boilers to which the conveying system feeds the coal, are to the special design of Messrs. Richard Crit-

tall & Co., Ltd. They are of the Return Tube Dryback type, 6 feet in diameter, with flues 3 ft. 6 in. diameter. Each boiler has 1,278 sq. ft. of heating surface, made up as follows:—

Furnace tube	110	effective
Return tubes	950	"
Shell tubes	218	"
Total	1,278	sq. ft.

They are fixed in the usual brick seatings, the waste gases being carried into an underground main flue, which communicates to a vertical chimney shaft with an internal diameter of 4 ft. 10 in. and a height of 200 feet.

It was desired by those responsible for the boiler-house installation to fire the boilers with slack coal having a calorific value of about 11,000 B.t.u.'s, and one of the conditions was that the fire must be smokeless and that no dust or grit should be emitted from the top of the chimney shaft. These conditions were met by installing "Bennis" patent high temperature smokeless and gritless coking stokers, which are designed and constructed on the principle of securing complete combustion on the grate itself by the admission of a proper quantity of air to perfect chemical combustion. The guarantee given with these coking stokers by the makers was that they would obtain, with ordinary Lancashire slack at about $2.00, as high a thermal efficiency as hand-firing with the best smokeless coal at about $4 per ton. This efficiency was to be obtained without either smoke or grits from the chimney, at a duty of 5,500 lb. of steam from and at 212 degs. F.

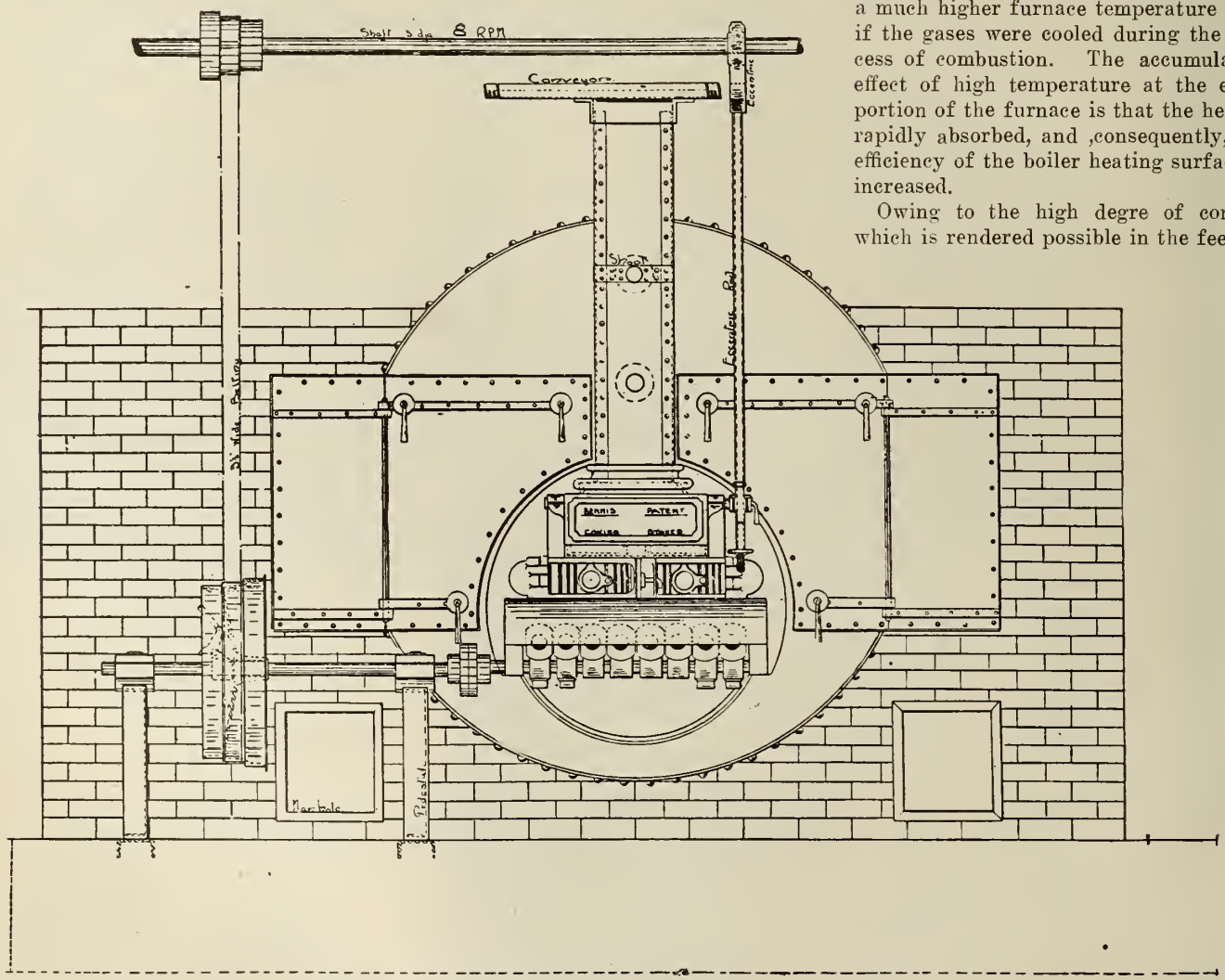
Description of Stokers.

A brief description of the "Bennis" patent high temperature coking stoker and self-cleaning compressed air furnace would here seem desirable. The stoker itself consists of a feed box in which two rams operate in troughs, one for each side of the furnace. The stroke of these feed rams can be independently regulated so as to distribute the coal evenly across the furnace. These rams are worked from a rocking shaft, which can be dis-connected to allow of the smoke box doors being opened. This rocking shaft is worked by a crank and connecting rod from the feed gear box; the gears in this box being of steel and machine cut, and working in an oil tight case.

The furnace consists of eight "Bennis" patent hollow bars, which carry the furnace grids. These bars move backward and forward by means of chilled cams in such a manner as to travel the fuel correctly along the furnace. Air is forced into the bars by means of outside steam jets. This system of firing ensures that an equal quantity of air is forced in at every portion of the furnace, thus preventing the possibility of an excess of air escaping through thin portions of the fire. The trough bars are entirely self-cleaning.

At the front of the main furnace there is a series of small upper grids. To these grids is admitted the correct amount of air necessary for the coking of the fuel. The effect of this is to produce a white hot fire near the front of the furnace, thereby ensuring that the coal, as soon as it is fed on to these small upper grids, is immediately lighted. Further, the air spaces in the main furnace grids are so regulated that combustion is complete at an early stage—there is no after burning of CO to CO_2. This results in a much higher furnace temperature than if the gases were cooled during the process of combustion. The accumulative effect of high temperature at the early portion of the furnace is that the heat is rapidly absorbed, and ,consequently, the efficiency of the boiler heating surface is increased.

Owing to the high degre of control which is rendered possible in the feed of

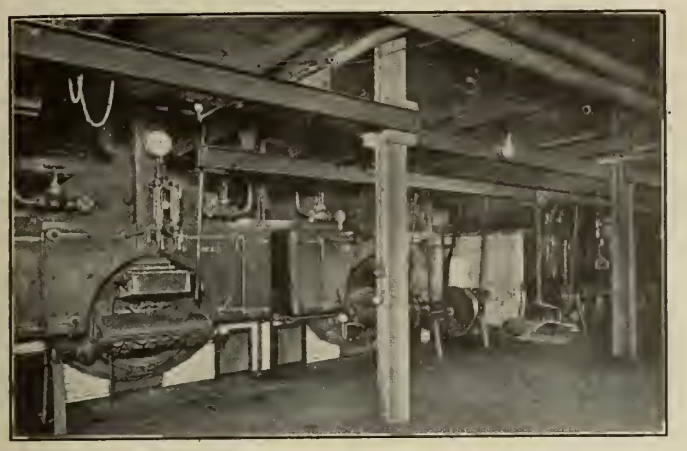


BOILER FRONT SHOWING STOKER OPERATING APPARATUS.

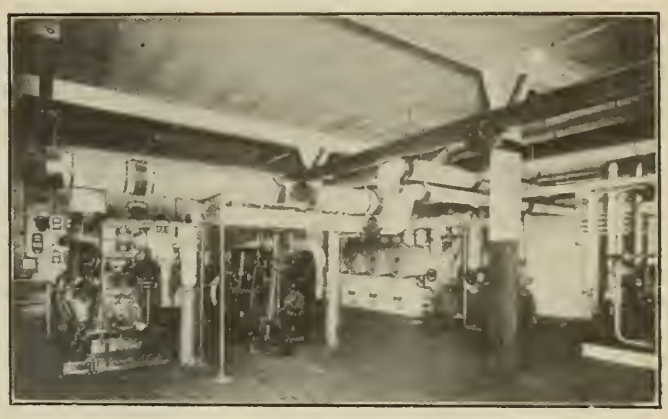
the coal on to the furnace, the speed of the furnace bars, and in the amount of air forced into the furnace, almost perfect combustion can be obtained through a wide range of duties. For instance, of all working parts, reduce the cost of repairs per annum to a practically negligible amount. In making this statement of course it is assumed that fair treatment is accorded the machines.

—a combination adequate to control the rate of combustion.

(4)—Combustion without smoke, grits or dust; the compressed air furnace cleaning into the ash-pit, which is a closed chamber.



VIEW IN BOILER ROOM OF ROYAL LIVER BUILDING.



POWER HOUSE OF ROYAL LIVER BUILDING.

on the dry back boilers, it is easily possible to burn efficiently from 100 lb. to 550 lb. of coal per boiler per hour. Further, owing to the ease of regulation and complete control of the air supply, sudden variations of load can be readily met. The simplicity of the working parts, the running of all gears in oil-tight cases, the chilling of the furnace movements, and the interchangeability

Stoker Features,

To familiarize our readers who may be unacquainted with the design of the "Bennis" high temperature coking stoker, the following tabulation is offered:—

(1)—The power of rapidly lighting back which carries with it the power of feeding a much larger amount of fuel on to the furnace and getting it burnt.

(2)—A higher and more even furnace temperature induced through the scrubbing of the coke by the air blown into the fire through the very fine air spaces of the compressed air furnace bars.

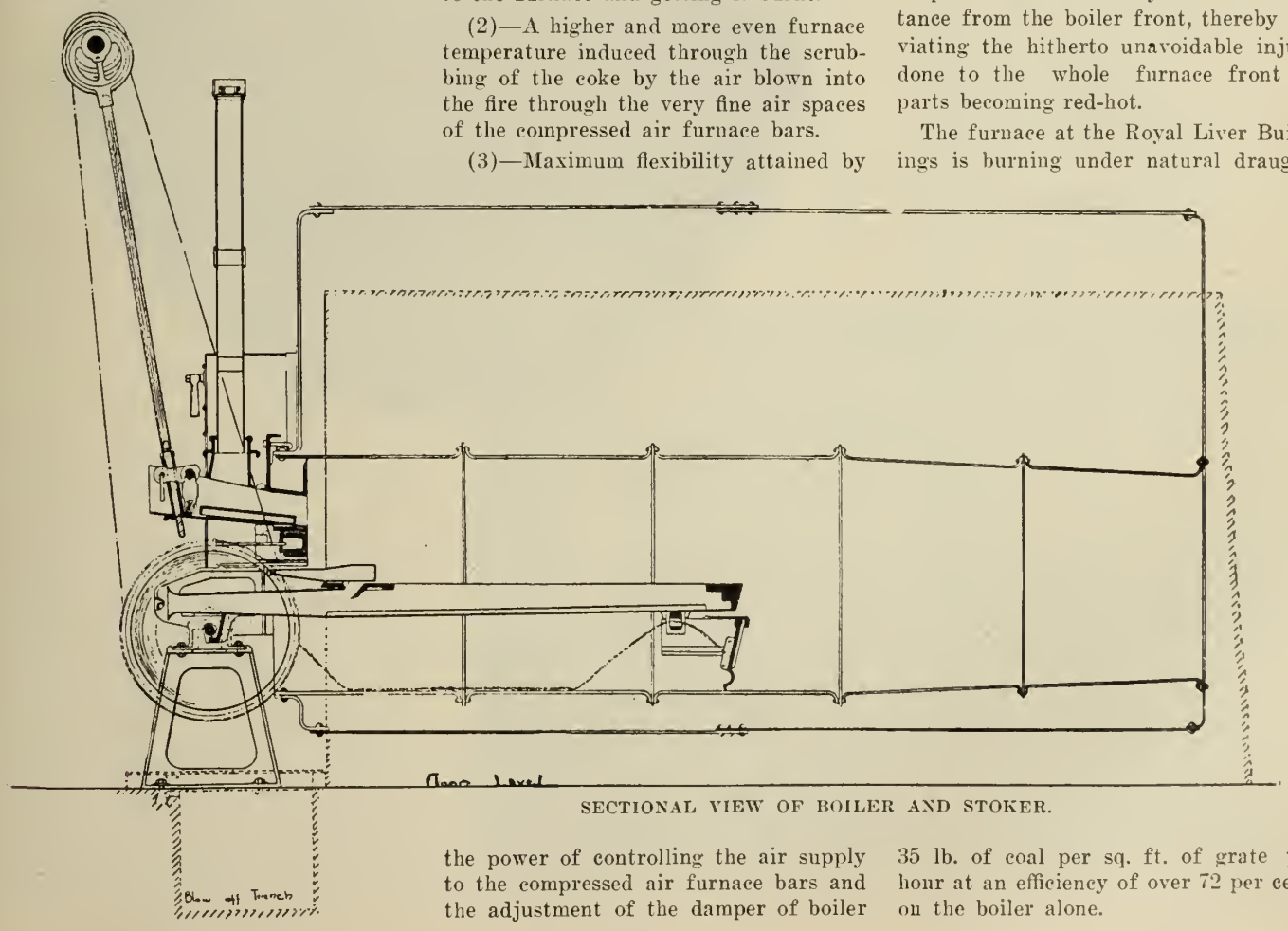
(3)—Maximum flexibility attained by

(5)—Simple and easy manipulation, there being but two adjustments for the fireman to make, one that determines the rate of feed by turning a nut, and the other that regulates the air-feed by means of a valve.

(6)—Low cost of upkeep, the parts being few, and the feed motion simple.

(7)—Ventilated dead-plate bars which keep the fire at a nicely-calculated distance from the boiler front, thereby obviating the hitherto unavoidable injury done to the whole furnace front by parts becoming red-hot.

The furnace at the Royal Liver Buildings is burning under natural draught,



SECTIONAL VIEW OF BOILER AND STOKER.

the power of controlling the air supply to the compressed air furnace bars and the adjustment of the damper of boiler

35 lb. of coal per sq. ft. of grate per hour at an efficiency of over 72 per cent. on the boiler alone.

Ash Removal.

The removal of ash is always a vexed question on acount of the additional cost. In the Royal Liver plant, the ash is conveyed by means of a simple and efficient device which is exceedingly economic in action. The girders which carry the coal conveyors, and additional girders fitted behind the boilers and between the buttresses, are utilized for the suspension of an ash track. This track curves round from the front of the end boiler into the corner of the end store. A combined runner and self-supporting pulley block travels along the tracks. From the block is suspended an ash skip. When cleaning out it is only necessary to swing the skip under the flue so that it hooks on to a catch fitted to the flue, and thus permits the ashes to be drawn out of the back chamber directly into the skip without spilling on the floor. The skip is then unhooked from the flue mouth and pushed along to the front of the tube where it is hydraulically hoisted to the street level and tipped. By this method, the boiler-house is kept free from dust or ashes about the floor.

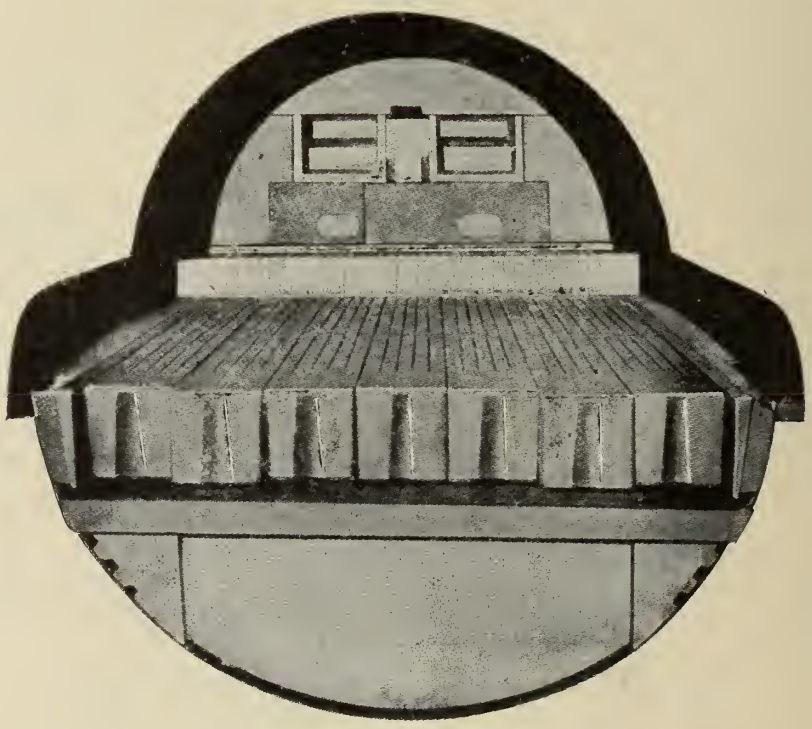
The Heating System.

In conclusion, it may be said that the entire system of heating was designed and carried through by the contractors, Richard Crittall & Co., Ltd.; close personal attention having been bestowed on the work by Mr. J. L. Musgrave. By the Crittall patent system of heating, the walls of the building are warmed to a few degrees above the temperature at which it is required to have the rooms. There is no radiator or exposed pipe system. This direct method of heating the walls themselves obviates the local heating of the air which invariably occasions the "stuffy" sensation resulting in headache and other unpleasantnesses. The air in the rooms by means of the "Crittall" system is maintained at a uniform temperature throughout; thus it is not necessary to heat a room to anything like the same extent to ensure comfort.

The heat is conveyed to the walls by means of a hot water pipe system, which is under the direct control of the occupants. It should be stated that the heating system is invisible, when completed, to the occupants of rooms. Jointless pipes of small bore are embedded in a special patent composition which sets into a smooth jointless surface that can be made to attain any degree of hardness, or to take a variety of color. This composition is used both for the hygienic flooring and for the wall panels beneath each window. All the piping has joints welded by the oxygen-acetylene process, after which they are subjected to a very high pressure test before being covered. It has been computed that there are no less than fifty miles of small bore tubing laid in the flooring and walls. The consulting engineer made exhaustive tests of the system before adopting it. In the winter, the steam from the boilers first drives the electric power steam generators and the exhaust heats the circulating water in four large calorifiers. The circulation is aided by centrifugal pumps.

Ventilation of the offices is secured by means of exhaust shafts leading to powerful centrifugal-cased fans discharging into the open air at the roof level.

In addition to the load above described, the boilers raise steam to generate the power that is required for working fourteen high speed electric lifts. Ashworth & Parker's vertical engines are responsible for the generation of current. There is given a view of the power house showing the electric plant.



PORTION OF "BENNIS" COKER STOKER.

Attendance.

When the size of the building is considered, the ten stories of which rise sheer from the pavement, its appearance dominating the Mersey front, its towers being visible miles away, it is a matter for surprise that the whole of the steam-raising and coal-handling plant installed in the boiler-house can easily be attended to by one man. It has been computed that from three to four thousand people can be easily accommodated in the building, and that it contains 35,000 square yards of letting space. The framework may be described as that of an enormous skeleton consisting of reinforced concrete columns carried down from the roof to the ground, and connected by concrete beams on which the floors and walls rest. Some of the columns rise in an unbroken length to a height of nearly 300 feet., and carry loads ranging to 1,500 tons each. One of the largest beams is that of the 9th and 10th floors, supporting the towers, which has a span of 42 ft., and carries a portion of the load from another beam as well as other concentrated loads to a total of nearly 290 tons. The largest arched beam in the building carries 1,480 tons. No scaffolding was used during erection.

STEAM TURBINE RUNNING.

A WRITER of an article on "Steam Turbine Running" has recently pointed out that the water gland packing ensures a perfect closing of the turbine, but the runner, forming a little centrifugal pump which forces the water into a circumferential sealing space, absorbs a certain amount of power. Besides, if the water is not perfectly clean, it will deposit scale in the glands, which has to be removed—sometimes frequently. Finally, the water which passes into the turbine will evaporate there, and may cause the formation of a considerable layer of scale on the blades, with a very detrimental effect on the steam consumption. The water supply must be carefully regulated to keep the leaking quantity as small as possible. To avoid evaporation in the glands, the temperature should be the lowest obtainable. The water should come to the glands with a few pounds pressure.

THE McARTHUR BUILDING, WINNIPEG.

THE McArthur Building, Winnipeg, is one of the busiest in that progressive city, a constant stream of people passing in and out all day. It was erected in 1909 and at present writing still enjoys the distinction of being the highest building in the city. Situated on the north side of Portage Avenue, near Main Street, it is right in the heart of the business district, and its 114 suites of offices provide accommodation for between 350 and 400 different firms. The building consists of twelve storeys, with basement, attic and penthouse. The attic is given over to janitor's living rooms, etc., and the whole ground floor is occupied by the jewelry store of the D. R. Dingwall Company.

The building is served by three Otis-Fensom elevators which carry, on an average, 9,000 passengers each day. Signals to the operators are made by a flash system installed by the Elevator Supply & Repair Co., Chicago. Suppose a person on the sixth floor wishes to go down. He pushes the "down" button which will cause a light to flash in the cage as the latter descends past the seventh floor, thus notifying the operator that he is required to stop at that floor. The "up" button notifies ascending cars in just the same way.

The Power Plant.

The power plant is located in the basement where it is somewhat cramped for room. There are two hand-fired boilers, rated at 250 h.p. each. They are of the Scotch marine type, fitted with the Burk's smokeless furnace. Each boiler has one 4-inch safety valve set to blow off at 125 lbs. pressure. Natural draft is provided by a steel stack 186 feet high by 4 feet diameter, the lower part being lined with asbestos. The coal is weighed on being brought into the boiler house from the bunkers, and the ashes are weighed at the end of the run—the day being divided into two runs of 11 hours and 13 hours each. The ashes are raked by hand from the ash pits, shovelled into steel buckets, raised to ground level by an electric hoist, and dumped into wagons.

There are two Robb-Armstrong horizontal single cylinder high speed engines; one has a cylinder 15 in. x 16 in., and the other is 18 in. x 16 in. The latter is direct connected to a 125 k.w. Canadian Westinghouse generator, while the former drives a 75 k.w. machine of similar make. These are multipolar D.C. machines running at 250 r.p.m., and deliver current at 240 volts to a 3-wire system.

In the Westinghouse 3-wire D. C. generators, four equidistant taps are made in the armature winding, and each pair of taps, diametrically opposite, is connected together through a choke coil. The middle points of the two choke coils are connected together, and this junction constitutes the neutral point to which the third or neutral wire of the

THE McARTHUR BUILDING, WINNIPEG.

system is connected. A constant voltage is maintained between the neutral and outside wires which, within narrow limits, is one-half the generator voltage. The generator shaft is extended at the commutator end, and there are here mounted four collector rings, and four collector brushes and brush holders, in addition to the regular direct current brushes and brush holders. Two voltages are of course obtained, 240 volts (as generated) across the outer wires and 120 volts (for lighting circuits) between outer wires and the neutral.

The voltage is regulated by a Tirrill regulator, but the engine governors have proved so sensitive that the regulator is really unnecessary. Should the governor stick, however, the Tirrill regulator will keep the rise of voltage within extremely narrow limits, not allowing a rise of more than one-half volt. The engines have given excellent satisfaction all along. They were built extra heavy to withstand sudden fluctuations in the elevator load.

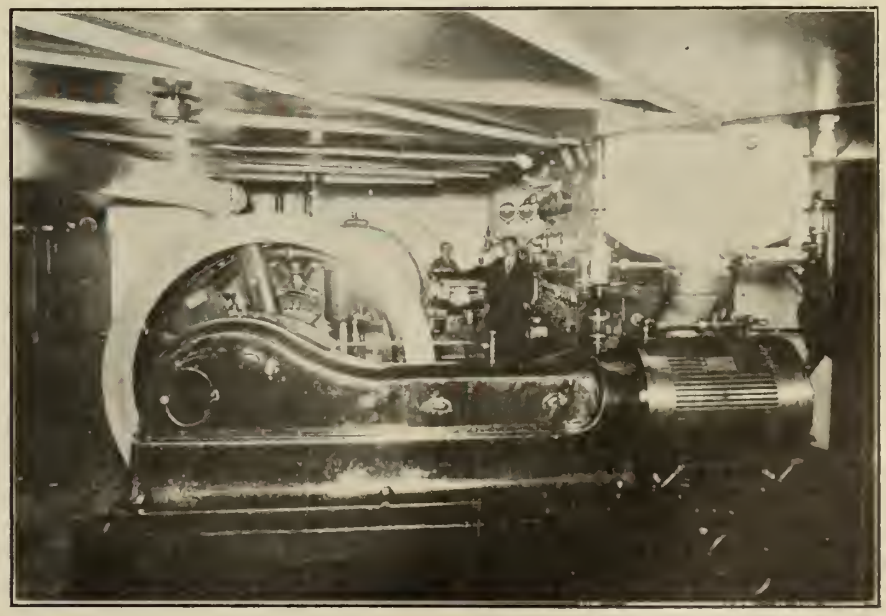
The Switchboard.

The Canadian Westinghouse Co. furnished the switchboard which consists of five panels of blue Vermont marble one panel being a spare. Two panels are devoted to the power and the lighting circuits and two to the generators. The equipment includes two sets of circuit-breakers for each generator; two voltmeters and four ammeters (two not used); and two totalising wattmeters, one for power and one for light. All lighting is by 40- and 60-watt tungsten lamps.

Near the switchboard is a handsome instrument board on which are grouped the air, vacuum, steam, back pressure and water service gauges, etc.

Feed Pumps and Other Auxiliaries.

Duplicate 6-4-6 Advance duplex feed pumps were installed by Darling Bros., Montreal. There are two feed lines, and the pumps can also be connected to the blow-off line, so that should the latter become choked up, it can be flushed out by the feed pumps. The boilers blow off into a sump tank, and another sump tank takes all the weeping drainage. The blow-off sump is emptied by a motor-driven centrifugal pump,



INTERIOR OF ENGINE ROOM— McARTHUR BUILDING, WINNIPEG.

since the basement is below sewer level. The line to sewer is of course fitted with a non-return valve. The weeping drainage sump is emptied to sewer by a steam-driven 4-3-4 pump.

The boiler feed passes through a Webster heater. In summer it is heated by part of the main exhaust, the remainder of which is used for heating the hot water supply for the building before passing to the atmosphere. In winter the heating returns are passed through the Webster heater by the vacuum pump and so heat the feed. Part of the main exhaust may be used if necessary, but the condensation returns are usually at a sufficiently high temperature for the purpose.

Heating and Ventilation.

The building is heated by both direct and indirect radiation. The direct system is by radiators heated from the main exhaust line on the overhead system; that is to say, the main exhaust header runs to the top of the building and feeds down, the back pressure valve being located at the highest point. The temperature is automatically controlled by thermostats on the Powers system of heat regulation, compressed air for which is supplied by a small duplex steam pump in the engine room.

Ventilation is provided by two Sturtevant fans, one for the Dingwall Co.'s store, 4 ft. dia., and one for the rest of the building, 8 ft. dia. They are driven by Morse chains from variable speed 240 volt motors running at 680-840 R.P.M.

The inlets of the air ducts are on the second storey with a view to getting a good clean supply. The air is washed by a water spray and then delivered by the fans throughout the building by steel ducts. The spray water is taken from a reservoir by a small direct motor driven centrifugal pump and circulated through spray tubes, after which it falls back to the reservoir. The water is changed once a day. In winter, before reaching the washer and fans, the air passes over steam coils heated from the exhaust line and connected to the common return of the heating system. When necessary, these coils may be heated by live steam without interfering with the main heating system.

In the penthouse at the top of the building, there is a 24-inch exhaust fan, direct motor driven, which gives efficient ventilation to all lavatories.

Water Supply.

The cold water supply is taken from an artesian well, 408 feet deep by an air lift which discharges to an open tank of about 500 gallons capacity. Air for this lift is supplied by a 6x6 inch air compressor, chain driven from a 7½ h.p. motor, which is automatically controlled by a Cutler-Hammer starting box. From the above mentioned tank the water is forced at a pressure of 110 lb. per sq. inch into a pressure tank in the basement by a 12-10-12 Marsh pump, and rises thence throughout the building.

To provide hot water supply, cold water is taken from the service line to a cylindrical tank of about 800 gallons capacity. From the bottom of the tank it passes into a small cylinder 8 ft. long, and is there heated by exhaust steam coils. It then passes back into the top of the main tank and rises throughout the building under its pressure of 110 lbs.

Fire Protection.

Running up outside the full height of the building there is a 3-inch pipe line, which can be connected to the city high pressure system. It has a branch at the top to which the city fire brigade can couple up, thus saving the time and labor that would otherwise be spent in dragging hose to the top of the building. In addition to this there are located in several places on every floor, lengths of hose with fire nozzles attached. These are connected to the water service pipes, which, as previously mentioned, carry a pressure of 110 lbs per sq. inch.

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MULTIPLE-VOLTAGE ELECTRIC TRACTION.

A PATENT recently issued to Mr. H. Ward Leonard, Bronxville, New York, is concerned with means and methods for operating electrical vehicles over long distances by the use of high-tension current, and through cities, towns, tunnels, or other desired sections at a relatively low and safe tension. A number of different locomotive arrange ments are covered, employing alternating current high-tension energy and both alternating and direct current low-tension supply with provision motors for either direct or alternating current.

When direct-current motors are employed with alternating-current supply, motor generator sets are used on the locomotive. If a high tension single-phase supply is used, the current is led from the working conductors through moving contacts carried by the locomotive to two single-phase motors, each of which is directly connected to a generator. These generators, which are preferably of the low-tension direct-current type, supply the propulsion motors. The pressure in the motor circuit is regulated by varying the strength of the generator fields, which are supplied from a separate generator through reversing rheostats. When the locomotive enters a low-voltage direct-current section, a switch brings the field of one of the generators under the control of its rheostat. This is adjusted to relieve the generator of its load, and the latter is connected to the low-tension source of supply. The high-tension supply circuit is then transferred to this generator, which now operates as a motor to drive one of the single-phase motors as a generator. The power from this unit is employed to drive the other single-phase motor, and this in turn drives the other generator to which it is connected.

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SAW MILL REFUSE AS PRODUCER GAS FUEL.

THE value of sawmill refuse as a fuel in gas producers is the title of an interesting paper which was recently read before the Association of Engineering Societies in the United States, by Mr. Charles E. Snypp. In the course of the paper the author remarks:—"The refuse that we use is known as 'cypress hog.' It consists of about 50 per cent. of sawdust and 50 per cent. of chips such as are discharged from the "hog," which is a machine used by sawmills to destroy their refuse. This material runs from 30 to 55 per cent. moisture, and this moisture seems to be necessary for best working conditions. We have to guard against the sawdust blowing over into the pipes which conduct the gases to the wet scrubber. This is probably a local trouble, due, no doubt, to the strength of the blast that we use in order to get capacity. We have been able to realize full capacity using sawmill refuse, and our engines deliver a brake horse-power on about 4½ lb. of this fuel.

The changes necessary to fire sawmill refuse are merely the removing of the coal dump hoppers and substituting a hollow cylinder about 10ft. high, slightly tapered and made larger at the bottom, and fitted with a slide gate, both top and bottom. These slides are worked with levers and the sawmill refuse is locked into the producers through these tubes. To start firing a producer with sawmill refuse it is not necessary to have an underlying bed of cinders or ash to cover the blast pipe."

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Insufficient Illumination.—It is estimated that 25 per cent. of industrial accidents are due to insufficient illumination. This is particularly true where workmen pass from daylight to places lighted artificially. The artificial light may be sufficient for those accustomed to it, but the eye does not respond immediately to the change in light when passing from a very bright illumination to a place lighted at low intensity. It is therefore, important that lamps be placed along walkways and thoroughfares rather than distributed uniformly over the whole floor.

Commercial Utilization of Peat for Power Purposes*

By H. V. Pegg

In Canada as in other countries, much research work has been undertaken to put on a commercial basis for power generation and domestic purposes this product of the many square miles of territory which is otherwise lost to the service of the great majority of mankind. The concentration of effort and interchange of ideas, methods and results is contributing to a much better understanding on the subject, and there is likely to be in the near future some thoroughly reliable data available as to value or otherwise of this commodity in competition with other well known fuels.

THE question of the utilization of Peat Fuel for power purposes has received a large amount of attention from engineers for many years past. Efforts in this direction have mostly taken the shape of some form of preparation of peat fuel in order primarily to get rid of the superabundant moisture in the fuel. Very large sums of money have been spent on peat-preparing machinery with generally very inadequate results; hence it has always appeared to the author that, in order to bring the utilization of peat to a commercial level, the first consideration would be the utilization of the peat as far as possible in the condition in which it leaves the boglands without any preliminary and expensive machine treatment.

Gas Producer Experiments.

The author had the opportunity about seven years ago of experimenting with air-dried hand-cut peat, fired into a special form of gas-producer. With all gas-producers using bituminous fuel, the main trouble is to get rid of the tarry by-product. In this instance, the gas-producer was arranged to work intermittently, there being periods of "blowing" during which the fuel in the producer was urged to incandescence, and periods of gas-making during which the tarry by-products were passed through the incandescent fuel where they were split up into gas. The chief difficulty experienced with this plant was the high thermal value of the gas generated—about 330 B.Th.U. Owing to the high and varying percentage of hydrogen in the gas, it proved unsuitable for use in the works gas-engine; and although the plant was running more or less continuously for ten days, driving the whole works, very considerable trouble was experienced, not only in the engine, but also in the plant, owing to the varying moisture content of the peat, the producer plant being decidedly sensitive in regard to this latter point. From the experience then gained, it appeared evident that it would be wiser to extract the tar from the gas, rather than to try to utilize the same by converting it into gas, and further that the producer must be comparatively non-sensitive to the amount of moisture in the peat fuel.

Some two years ago the author discussed the question of the utilization of air-dried peat fuel with Mr. Hamilton Robb, of Portadown, who, having large supplies of such fuel convenient to his factory at Portadown, was strongly of opinion that it should be possible to utilize it in order to generate the power required in the factory. As the result of various tests run with an experimental plant at the works of Messrs. Crossley Brothers, Openshaw, a special plant was eventually manufactured by them under their designs and patents and to the author's specifications. This plant, which has been running since last September, has been so often dealt with in the daily and technical press that there is no need for the author to dwell upon the details of the plant, but he proposes to make a few remarks in regard to the difficulties experienced.

Air Dried Peat Difficulties.

Air-dried peat is not a very convenient fuel to fire into the producer, and as it was uncertain whether it would be possible to burn the fuel direct in the form in which it came from the boglands, provision was originally made in the plant to deal with peat fuel prepared by being reduced in size to blocks of about 5 inches cube. It was found possible, however, to dispense with the preliminary treatment, and the construction of the plant was thereby considerably simplified.

As regards the general running of the plant, last October it was subjected to a test run of six hours' duration with a load of 250 b.h.p., the peat consumption per b.h.p.-hour averaging 2.55 lb., and the peat fuel containing 18.98 per cent. of water. This was with both producers running, although the load was considerably below the total capacity of the plant. When necessary, it has been found that the above load can be safely carried with either producer working singly, and the plant has run under these conditions for several days.

It will be noted that the percentage of moisture in the fuel during the above test was unusually low. This was owing to the unusually dry summer of 1911. During November and especially December last, the fuel fed to the plant was extremely wet, as the rainfall in those months was very heavy and the fuel-supply was and is entirely exposed to the weather. The plant, however, worked just as well with sodden peat as it did with the drier peat, the only difference being the amount of fuel consumed. The amount of water in this "sodden peat" varied considerably from day to day, and the exact percentage was not arrived at; as near as could be estimated, it was at least 70 per cent.

Separation of Tar From the Gas.

The separation of the tar from the gas was the chief difficulty to be overcome and it was found better to rely on an ample water-spray through which the gas passed rather than any form of a coke-scrubber, as the coke rapidly became clogged with tar. The main portion of the tar was thrown out into a tar sump by a centrifugal tar-extractor; but unless the gases were subjected to a thorough washing and cooling by the water-spray above referred to, it was found that a certain proportion of tar got past the extractor, collected in the gas mains and finally found its way into the gas-engines. It was a matter of experiment as to the precise amount of water sprayed into the cooler which was necessary in order to insure that the tar vapour should be sufficiently condensed before reaching the centrifugal extractor, so as to enable the latter to effect the needful separation. As now arranged, the proportion of tar in the gas after passing the extractor is small, and the engine-valves do not want cleaning out more than once a week.

Cleaning Requirements.

When first started, the plant generally, and especially the producers required a thorough cleaning once a week; at the present date the plant can be run if necessary for three weeks without cleaning, though the weekly cleaning generally takes place as a matter of policy. This result has been obtained owing to the increased amount of washing-water used, which now amounts to about 7 gallons per b.h.p. per hour. The proportion of tar recovered is about 5 per cent. of the weight of fuel consumed, and during the initial stages of the

*Abstract of paper read at the Belfast meeting of the Institution of Mechanical Engineers.

running of the plant, a certain amount of this tar was sold to tar-felt manufacturers at a price of $8.50 per ton, but sales in this direction ceased owing to an, at present, ineradicable pyroligneous odour which persistently clings, not only to the tar itself, but to all the various oils distilled therefrom.

Tar in Oil Burning Boilers.

Experiments have also been made with the tar in oil-burning boilers, but owing to the very high percentage of water in the tar—up to 50 per cent., and the large quantity of solid matter also present, a very large amount of preliminary treatment is necessary. For a considerable period the tar at Portadown was used mixed with coal and burnt under a Stirling boiler; the precise heating value of the tar so consumed has not been ascertained. At the present time, the whole factory at Portadown is run entirely on peat fuel, the consumption being about 44 tons per week, of which the producer plant takes about 22 tons. The nature of the peat varies considerably; with good black heavy peat the weekly consumption for all purposes drops as low as 35 tons; and with light top peat from the surface of the boglands the consumption rises to 54 tons. It is also interesting to note that the quality of the peat is reflected in the carrying capacity of the barges which bring a load of 35 tons with heavy peat and 24 tons with light peat. The peat is unloaded from the barges and conveyed to the producer platform and boiler house by a transporter. Clinker troubles are not often experienced, being only when burning the inferior grade of peat; the presence of sand in the fuel causing the trouble.

Comparative Fuel Cost.

The author is indebted to Mr. W. A. Mullen, manager at the factory of Messrs. Hamilton Robb, Ltd., for the following figures regarding the cost of fuel, these figures being given as at the 12th of June last:—

Cost of running Factory on Coal per week.

8½ tons of anthracite @ $8.50	$72.25
19 tons of steam coal @ $4.00	76.00
	$148.25

Cost of running Factory on Peat per week.

Say up to 50 tons of Peat @ $1.50	$ 75.00
Weekly saving	$ 73.25

Allowing $4 for extra labor, the net weekly saving figures out at $69.25.

Ammonia Recovery Plant Installation.

The author would here refer to the letter in "Engineering" of 26th January last, in which the General Manager of the Power Gas Corporation, Ltd., gives some very interesting particulars of peat plants, more especially an ammonia recovery plant working in the South of England. The amount of nitrogen in the South of England peat is apparently high, and would appear to be considerably more than in the peat used at Portadown, analysis of which is appended hereto, together with analysis of the refuse tar and gas from the producer.

Tar Analysis—Sample 2.

The sample was grey when received, but very quickly turned black. On distillation it yielded:—

	Per cent.
(1) Water	37.2
(2) Light oils (distilling below 230oC).	5.8
(3) Middle oils (distilling at 230-270o C)	8.3
(4) Heavy oils (distilling above 270o)	23.2
(5) Coke	17.8
(6) Loss	7.7
	100.0

Much frothing occurred until the water was distilled off. Towards the end the temperature went higher than a mercury thermometer will record (360 degrees C.). The different fractions obtained were as follows:—

(1)—Water, faintly acid to litmus. Phenol could not be detected.

(2)—Light oils (below 230 degrees C.) became rapidly dark red in color. Specific gravity of crude liquid 0.930.

(3)—Middle oils (230-270 degrees C.) became dark red. Specific gravity of crude liquid 0.944.

(4)—Heavy oils (above 270 degrees C.) on standing, crystals of paraffin wax separated out to the extent of 5.42 per cent. of the fraction (=1.26 per cent. of the original tar). The specific gravity of the liquid portion of this fraction was 0.906. The following is the analysis of a sample of peat received on 14th September from Mr. Hamilton Robb, Portadown.

Proximate Analysis.

	Per cent.
Water	18.98
Volatile matter	55.17
Fixed carbon	24.75
Ash	1.10
	100.00

Ultimate Analysis.

	Per cent.
Carbon	44.60
Hydrogen	5.42
Nitrogen	0.97
Ash	1.10
Moisture	18.98
Oxygen (by difference)	28.93
	100.00

The undermentioned figures give the analysis of an average sample of gas during a ten-hours' trial.

Moisture in Fuel 26 Per Cent.

CO_2	10.6
CO	21.0
H_2	13.0
CH_4	3.7
Total Combustible	37.7 per cent.
Calorific Value (calculated from analysis)	144.0 B.Th.U.

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DURABILITY OF BALL BEARINGS.

A REMARKABLE record of the service of ball bearings was recently shown by an investigation made by a prominent consulting engineer. Two ball bearings made by a company in Philadelphia were installed in one of the journal boxes of an electric car of the Atlantic City and Shore Railroad, which runs over all the street railway lines in that district, and after 3½ years' service, when the car had run about 150,000 miles, the journal box and its two bearings were removed for measurement. It was found that the mean or average radial freedom was 0.000046 in., or practically nothing, and the mean end play was 0.00125 in. The mean or average eccentricity of the inner race was found to be only 0.00004 in. also practically nothing. The mean radial freedom for the second ball bearing was found to be 0.0003 in., the mean or average end play 0.0097 in., and the mean or average eccentricity of the inner race 0.00025 in. The larger wear shown in the second bearing, small though it is, is accounted for by the fact that this particular bearing had to take the end thrust of the axle. It appears that during the 3½ years of service no attention was required, other than the supply of grease every 10 or 12 months. It is also understood that owing to the fact that the axles did not have the customary end play there has been a distinct reduction of flange wear, with the result that there is little or no shock on entering a curve, while the side sway is diminished.

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EDUCATIONAL VALUE OF ENGINEERING MAGAZINES.*

By W. D. Robins.**

IN the engineering magazines, edited and published by present-day methods, there is a great deal of information which no ambitious man engaged in mechanical work can afford to overlook. A large and valuable part of this information is of such a character that it could not be obtained from any other source without a great deal of time and trouble. While familiarity with what is being done in the line of his profession is of undoubted value to the engineer who has attained a position involving important administrative or technical responsibilities, it is certainly of no less value to the draftsman or student whose experience is more limited.

Intelligent Study Desirable.

Without intending to imply that there is any agency equal to actual experience for developing and forming the sound, level-headed judgment required in all branches of engineering work, it is the purpose of this paper to show that the knowledge of current practice, in a

*From a paper presented at the regular monthly meeting of the American Society of Engineer Draftsmen.

**Office of Inspector of Machinery, U.S. Navy, Philadelphia, Pa.

particular line of work, which can be obtained by intelligent reading of the engineering magazines, will be of great value in applying to actual cases the fundamental principles of design or operation. Though all engineering work is governed by mathematical laws, the application of these laws to actual work is by no means the exact science which their mathematical origin would seem to indicate. This is due partly to incomplete knowledge of the laws themselves and partly to the variable character of the materials used and conditions of operation.

Editorial Features Current Practice.

Every student of machine design is familiar with the numerous formulas containing variable factors, such as factors of safety, safe stresses, empirical coefficients, etc., which represent the results of practical experience or scientific experiments. These factors, as given in the text books, often vary between wide limits; the proper value to be used for a given case being left largely to the judgment of the designer. By substituting in a formula the dimensions or quantities given in a magazine article describing a machine and then solving the formula for the variable quantity, an idea can be obtained of the value used in current practice for the class of work under consideration. The extent to which this practice may be carried out depends upon the opportunities of obtaining magazines and the time and mental energy remaining after the performance of the daily work. If it is not practicable to use the magazines in such a detailed manner as indicated above, it is still possible to use them to determine the application of principles in a more general manner.

Descriptive articles may show that for the same purpose, one power plant uses a direct-acting steam pump, another an engine-driven centrifugal pump and another an electrically-driven plunger pump. One bridge may be built of masonry, another of steel, and another of re-inforced concrete. Ship propelling machinery will be described in many combinations, from the torpedo-boat destroyer with oil-burning water-tube boilers and steam turbines, to the Western river steamer with flue boilers and simple engines exhausting to the atmosphere. By the habit of determining, as far as possible, from descriptive matter given, the reasons for the adoption, in any case, of the particular apparatus employed, a certain degree of familiarity with the subject is sure to be obtained. The practice of looking for the controlling factors of design is likely to develop the ability to determine what constitute these factors, and also what their relative importance is.

Engineers of high standing and varied experience have stated that the two most important branches of knowledge for a man engaged in engineering work are the principles of mechanics and the properties of the various materials used in the construction and operation of his work. Now, the principles of mechanics do not change; but materials do change, for the properties of materials continually vary with improved methods of manufacture, new materials and combinations of materials are being used, and familiar materials are being put to new uses. Much valuable information concerning materials and their uses can be found in the magazines long before it gets into text books.

The Advertising Pages.

Again, the advertising matter in an engineering magazine contains a wealth of useful up-to-date and instructive information, because the modern methods of advertising depend more upon directing attention to the character and efficiency of the article itself than upon making vague and spectacular claims for it and enveloping it in an atmosphere of mystery, as was too often the practice in the past. When it is remembered that the use of unsuitable material for pipe-joint gaskets or valve-stem packings might seriously impair the commercial efficiency of a large power plant, it is apparent that any material or appliance used in engineering work, however trifling it may seem at first glance, needs careful study and inspection.

In conclusion, the writer wishes to emphasize the fact that nothing in this paper is intended to belittle the importance of actual experience. It is intended, rather, to suggest methods of finding information of real practical value in a lot of reading matter which is often put aside as containing nothing but dimensions and statistics.

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TENDENCY OF DIESEL ENGINE DESIGN.

IT can safely be said that from the marine engineer's point of view there are few marine oil engines on the market. What we mean by a marine oil engine is one that has no parts that have not already been used and found perfect, or as near perfect as a hundred years of design and experience can make them in existing marine practice. Of course, the mushroom valve is new to marine work, and there seems no hope of ever getting rid of it so long as we adhere to the reciprocating form of motor. Admitting the necessity of the mushroom valve, there are all the new features to be considered, and these are chiefly cams, cam shafts, gear wheels, and vertical shafts. These parts can be altered in design to suit the marine man's views. For instance, the cams and rollers can be dispensed with and simple eccentric gear with rolling links substituted.

The F.A.T. motor is correct from this point of view only, but has the disadvantage of having the gear driven from the crankshaft in the way common to all oil engines, viz., skew wheels and vertical shaft can only be got rid of by driving direct from the crankshaft by means of eccentrics. These remarks, however, only apply to two-cyle engines, for with four-cycle engines, a two to one shaft is absolutely necessary, and this can only be driven by spur or skew gears or some other method alien to marine practice. At present there are no large two-cyle engines having the gear driven direct from the crankshaft. The only engines having this commendable feature are those of the Semi-Diesel type, such as the Beardmore, Kromhout, etc.

All the large Diesel engines which have appeared so far are deficient in this respect. To our knowledge they all have spur wheel drives, vertical shafts, and cam and roller gear. That these points will in the future be modified there is no doubt, and at present engineers are using such means only, because time does not permit of great revolutionary changes in design.

The marine oil engine, it should not be forgotten, is largely the land oil engine simply adopted for the special requirements of ship propulsion. The chief reason for this is that the demand for naval and mercantile work has been so rapid that oil engine people have been led into adopting the best of successful land practice. Again, the folly of fitting trunk pistons and enclosed cranks, etc., on large work was perceived years ago, and there are now several engines running with piston rods, cross-heads, and entirely open crank pits. The reason for this is obvious. With a completely open engine, the attendant can tell by what the French call "a flash of the eye," if every part is working properly and doing its duty. The crosshead pin and crank pin can be touched without inconvenience and without taking off doors, etc. Also it makes the engine much easier to overhaul, lubricate, and adjust. The open crosshead design was, of course, simple to arrive at, as it was only necessary to copy existing marine practice with modifications. The other matter, however, of driving the valve gear is quite new, and accordingly it will take more time to develop, since there is no precedent to guide engineers.

Machinery Display at the Canadian National Exhibition

The annual Canadian National Exhibition at Toronto has once again come and gone and as in previous years attracted enormous crowds. The Machinery Hall once more proved far too small, and this apparently deterred some concerns from exhibiting, as several prominent engineering and supply firms were not represented.

EXHIBITORS.

The Canadian Hart Wheels, Hamilton, Ont., showed a large selection of their Beaver brand of razor hones and corundum grinding wheels.

The Boiler Repair and Grate Bar Co., Toronto. were demonstrating their 20th Century shaking and dumping grate bar.

The Jas. Morrison Brass Manufacturing Co., Toronto, were located in the Process Building where they had a large booth in which were displayed numerous and varied specimens of the work turned out by them. The exhibit included pressure gauges, counters, injectors, marine engine-room telegraphs, etc.

The Canada Metal Co., Toronto, were located near the south entrance to the Machinery Hall, where they had a good display of their well-known products, including lead joints and plumbers supplies of all kinds, fuse wire, copper ingots, battery zincs, pig lead, spelter, etc. In addition, samples of their many brands of Babbitt were shown ,among which the Harris Heavy Pressure occupied a prominent place.

The Dodge Manufacturing Co., Toronto, occupied a large space with their well-known products for power transmission, including split wood pulleys, bearings, hangers, etc.

The Garlock Packing Co., Hamilton, had on hand a full line of their packings under charge of H. G. Fletcher, manager of their Toronto branch.

The Chicago Pump Co., Chicago, had on view their automatic electric condensation pumps for drawing condensation and air out of heating systems, and automatically returning the water to the boiler. The system is operated independently of the boiler pressure, no vacuum pump being used.

The A. R. Williams Machinery Co., Ltd., Toronto, had a good selection of machine tools including a flat turret lathe (Jones & Lamson type) by the Stevens Co., Galt; a Kearney & Trecker No. 1 Milwaukee miller; Schuchardt & Schutte No. 1 gear hobber; Gould & Eberhardt 14-inch shaper, etc., etc. They were also demonstrating the "Champion" tool holders made by the Western Tool & Mfg. Co., Springfield, Ohio.

The Canadian Morehead Co., Woodstock, Ont., were represented by Mr. Geo. W. Cole, who was kept busy demonstrating and explaining the special features of Morehead non-return, return, vacuum and condenser steam traps.

The Robt. Mitchell Co., Ltd., Montreal, were demonstrating the Wood's Oiler, which has recently been put upon the market. This cylinder lubricator is suitable for steam engines, gas engines, air compressors, etc., and has many novel features. It is a force feed lubricator, yet there is no pressure in the sight glass or oil tank. Lubrication is effected by a pump which is positively operated by the steam pressure in the engine cylinder and which delivers the oil to the steam pipe in the usual way. The manner of accomplishing this is extremely interesting and well worthy of investigation.

The Canada Machinery Corporation, Ltd., Galt, Ont., had on view some of their leading lines of iron and woodworking machinery. The former included a 16-inch shaper, and an 18 in. by 8 ft. standard engine lathe, while the latter comprised a standard chain mortiser, 16-inch jointer with Falls automatic undercut attachment, mitre saw, and 8 ft. glue jointer.

John Millen & Son, Montreal, had a large show case display of Coventry noiseless chains for driving purposes. They also showed a novel application of these chains to automobile change speed boxes. Another prominent feature of their exhibit was a group of Cyclone high-speed chain blocks ranging in capacity from ½ to 40 tons.

Wm. & J. G. Greey, Toronto, had a large show of flour mill machinery, among which were an improved oat-flaking machine, a dough mixer and adjustable dough divider for cutting up dough into equal portions. The exhibit also included steel conveyor buckets, hand trucks and general mill furnishings.

The Canadian H. W. Johns-Manville Co. exhibited their asbestos products, roofing material, fibre conduits for underground wiring, J-M and Red Seal dry batteries, and high temperature cements for furnaces.

Jones & Glassco, Montreal, showed numerous examples of Renolds' Silent Chain for which they are sole Canadian Agents. This driving chain is well-known to all power users. Among their other exhibits were specimens of the Kenyon patent inter-stranded cotton driving rope, made by Wm. Kenyon & Sons, Ltd., Dukinfield, Manchester, Eng. They also showed Skefko Ball Bearings.

D. K. McLaren showed their well-known British oak-tanned leather belting, besides steel split pulleys and other mill supplies.

The Borden-Canadian Co., Toronto., were kept busy demonstrating the Beaver die stocks for threading and cutting pipe. These die stocks have adjustable dies which do not require to be changed for the different sizes of pipe. Thus, the 6-inch die stock will cut all sizes of dies, and moreover, can be operated by one man.

The Dominion Belting Co., Hamilton, Ont., showed driving and conveyor belts made from their "Maple Leaf" stitched cotton duck.

The General Machinery Co., Traders Bank Bldg., Toronto, showed Luitwieler Pumps in operation.

The Chapman Double Ball Bearing Co., Toronto, showed many examples of their well-known annular ball bearings and double ball thrust bearings. One large bearing in particular attracted much attention. This, a 6-inch double annular ball bearing, has recently been added to the company's regular line.

The Carborundum Co., Niagara Falls, N.Y., showed numerous examples of their carborundum and Aloxite grinding wheels.

The Elmira Machinery and Transmission Co., Ltd., Elmira, Ont., showed shafting hangers and bearings, split wood pulleys, etc.

Cowan & Co., Ltd., Galt, Ont., had an extensive exhibit of their well-known lines of wood working machinery.

The Lumen Bearing Co., Ltd., Toronto, showed a great many samples of well-made die-castings on view.

La Societe d'Air Liquide, Montreal (formerly R. J. Levy), were doing oxy-acetylene welding and cutting in a tent outside the Machinery Hall. The company manufactures oxygen and liquid air and supplies complete oxy-acetylene equipments. They also do welding and cutting work by contract.

The James Morrison Brass Mfg. Co., Toronto, were located in the Process Building. Numerous and varied specimens of their well-known products were in views, such as steam and hydraulic pressure gauges, engine counters, injectors, stop valves, marine engine-room telegraphs, etc.

The Linde Canadian Refrigeration Co., Montreal, exhibited a belt-driven 20-ton ammonia compressor, operating in the Dairy Building. It was employed to care for the exhibits of the Farmers'

Dairy, the City Dairy, the Harris Abattoir, and others.

The Cling-Surface Co., Buffalo, were distributing literature and demonstrating the merits of their well-known belt-dressing.

The Tallman Brass & Metal Co., Hamilton, made a good display of their Arctic Babbitt Metal, as well as of brass rods and tubing, brass castings, brass signs, etc.

The Consumers Gas Co., Toronto, had a Crossley gas engine in operation, besides a number of gas accessories of various kinds. A furnace for hardening or annealing high-speed steel was shown, and also a gas fired rivet-heating furnace. This exhibit was in the Gas Building.

The Positive Clutch & Pulley Works, Toronto, exhibited a number of their wood-rimmed pulleys, with pressed steel spokes and malleable iron hubs. A features of these pulleys is their absence of windage. A combined jaw and friction clutch was also shown. In this friction, pieces made of fibre are employed to gradually pick up the speed of a shaft or pulley under load, after which the positive jaws are thrown into gear, the friction being disengaged at the same time. The whole operation is controlled by one lever.

The Ontario Wind Engine & Pump Co., Toronto, showed a large number of Strickney gasoline engines. One of 7 h.p. rested on two rollers of iron pipe without being bolted down. In addition, it had the covers removed from both journal bearings, and ran all day with very little vibration. The governor can be adjusted while the engine is running, and has a wide range.

The Crescent Oil Co., Hamilton, Ont., showed lubricating oils, split wood pulleys, "Alligator" flexible steel belt lacing, etc., etc.

Baines & Peckover, Toronto, showed "Lincona" balata belts, tool steels by B. K. Morton & Co., Sheffield; and babbitts by the Atlas Metal & Alloys Co.

S. F. Bowser & Co., Toronto, were located in the Process Building, where they exhibited their well-known self-measuring pumps. These pumps are a great convenience in a large engine room, garage, railroad roundhouse, etc., where large quantities of oil are handled. An adjustable stop on the pump rod varies the travel of the plunger, and so controls the amount of oil delivered at each stroke.

Chapman & Walker, Limited, Toronto, had a large exhibit of motors and other electrical equipment.

The Canadian Boving Co., Toronto, showed a single cylinder Bolinder Semi-Diesel engine of 12 H.P. in operation A feature of this type of engine is its extreme simplicity, there being only three working parts exclusive of the fuel pump and governor.

The Northern Electric Co., Montreal had a very handsome booth in the Industrial Hall, where they exhibited their telephones, fire-alarm, apparatus, etc.

The Dearborn Drug and Chemical Works, Chicago, were explaining the merits of the Dearborn treatment of boiler feed waters.

H. L. Peiler & Co., Montreal, exhibited a full line of Bundy steam traps and Mason regulators. Their booth was shared by

The Engineering Specialties Co., Toronto, who had on hand an assortment of "Everlasting" blow-off valves, "Flexible" tube cleaners, etc.

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THE TRAINING OF AN ENGINEER*

By S. W. Barnaby, M. Inst., C.E.

THIS is a subject upon which there exist very great differences of opinion among engineers themselves. There are many who disparage technical training altogether, and who think that the sooner a boy can enter the shops and get to practical work the better; that he cannot, in fact, spare the time necessary to become a college graduate, and that it is not necessary for him to do so, because he will be able to pick up all the technical training that will be of any use to him during the period of his apprenticeship.

Present Day Facts.

Now, this is not my view, and I believe it to be a wholly mistaken one. Many engineers in the past have, without doubt, done good work, and made large fortunes, who have had very little scientific training, but every year as engineering works advance in magnitude and importance, and as competition grows keener, the opportunities for the untrained man to compete successfully with the highly trained engineer will become less and less. Competition is so severe that in large engineering works, such, for example, as a big span railway bridge, material must be cut down to the lowest limit compatible with safety, to secure an order, and if over-eagerness to get a contract leads an incompetent man to underestimate the material required, a disaster occurs, such as the failure of the Quebec Bridge over the St. Lawrence. Our engineers are now having to compete with very highly trained foreign engineers in all the different branches of the profession, and unless they are equally equipped, and I am afraid that at present they are not so as a rule, they will find it increasingly difficult to succeed. The idea that a lad entering the shops at the age of sixteen can learn all the things that should go to equip an up-to-date engineer by study in the evening is, I think, very unreasonable when you remember how trying the long hours are to a youth of that age.

*Part I of abstract of an address delivered before the Hartley College Engineering Society.

Curriculum Suggested.

A very influential committee, presided over by Sir William White, sat last year to consider the best course to pursue in the training of an engineer. The question before them was not whether a college training or a workshop training was the best, there was no difference of opinion on that point, the need for both was fully recognized, the only question was whether the workshop or the college should come first, and they recommended that there should be one year spent in the works immediately after school, then the complete college course, followed by three years' practical training. This recommendation no doubt represents a compromise between the views of those who think the workshop should precede the college and those who think it should follow it. My own feeling is that is easier for a boy to do justice to a technical course when it follows directly on his school work. I know from personal experience how difficult I found the college work after an interval of three years spent in the shops, and I am very glad the committee have recommended that only one year should be interposed between the two courses. I have usually advised any who have consulted me on the subject of their sons' training, to enter them for a college course after leaving school at 16, and, if possible, to let them spend six weeks or so of the long vacation between the closing of schols at the end of July and the opening of the University Winter Session at the end of September, in some engineering works.

The distinction of an engineering degree is the privilege of only a few men, but it is within the reach of all of you who make the most of your opportunities here. It will be worth your while to keep in mind a maxim which a friend of mine, an earnest and successful schoolmaster, has inscribed on his school buildings:—"I shall not pass this way again."

I do not wish you to understand that this is going to be your only opportunity for educating yourselves. Indeed, from one point of view your engineering education can only be said to be well begun when you graduate from here; but it is here that you will be provided with the tools with which to carve out for yourselves your own fortunes. A workman poorly equipped with tools makes but a poor show in the world's workshops. Here and now is your opportunity to

possess yourself of a complete outfit with which to engage in your handicraft, and this opportunity will never, in the same measure, be yours again.

Sir John I. Thornycroft.

Sir John Thornycroft commenced boat building at a very early age at Chiswick, being not much more than a lad when his father set him up in a small yard there. He built some very successful launches, faster than any of the small boats on the river at that time, but he soon made up his mind that he had not the technical knowledge necessary to enable him to carry out successfully the original work which he was ambitious to do. He, therefore, shut up his works and went off to Glasgow University to study under Professor Rankine. There he met a student who became his partner shortly afterwards, Mr. John Donaldson, who had also relinquished an appointment and sold all his property in order to go to the University. When Mr. Thornycroft returned to Chiswick after the completion of his college course, he felt competent to engage in the bold pioneering work with which his name will always be associated, and, it is not too much to say that no better equipped young naval architects and marine engineers were to be found in the country than John I. Thornycroft and John Donaldson when they commenced the building of torpedo boats in the seventies.

Definitions of an Engineer.

You must make up your mind what tools you want in order to fully equip yourself as an engineer. Now, what is an engineer? I will give you some definitions, which are all of them good.

Tredgold, nearly a century ago, defined engineering as "The art of directing the great sources of power in Nature for the use and convenience of man." This is a definition it is hard to improve upon, and it is incorporated in the charter of the Institution of Civil Engineers. Another definition states that "Engineering treats of the intelligent direction of the laws governing matter, so as to produce effects which will reduce to a minimum the time and physical labor required to supply all the demands of the body of man, and leave more opportunity for the exercise of the mental and spiritual faculties."

Still another writer defines it as "A combination of science and art by which all strictly material productions that involve construction, either directly or indirectly, and which are serviceable to mankind, are evolved, designed and materialised." Someone who believes in short definitions has said, "An engineer is a man who 'does' things." I suppose this writer would seek to differentiate him from the theologian who "thinks" things, and the author who "writes" things, the lawyer who "says" things, and the doctor who "guesses" things! But short definitions are always incomplete, and in my opinion to be a thoroughly good engineer you want to be able to "think" things, to "write" things, to "say" things, and to "guess" things, as well as to "do" things, and to do all these well. To be a good engineer you must know something of everything and everything of something.

The Tools.

We were speaking just now of tools. I am not going to dwell on the essential ones, such as mathematics, mechanics, physics, natural philosophy and chemistry; you know without my telling you that you must have these in your outfit, especially the first, but put down in your list of the tools that will be useful to you, the acquirement of a good style of writing. You will be called upon to write reports upon some test, or experiment, or piece of field work. It is not only necessary to express yourself clearly and tersely, but it is useful to write a good legible hand and good legible figures, and not to forget the importance of correctness in spelling. Just when a man is trying to get his start in life, a little thing like a good style in handwriting, and ability to write a business-like letter, may just turn the scale in his favor when he is being weighed against a number of applicants personally unknown to those who have to make the selection.

Should you have occasion to make application by letter for a post as draughtman, assistant manager, surveyor, or the like, let your letter be a plain, simple statement of what you have done, and do not always seek to make out that you have been in charge of the particular piece of work upon which you have been engaged unless it is an incontrovertible fact. It may happen that the person to whom you are writing knows the man who really was in responsible charge, and your exaggerated pretensions will then make a bad impression.

When you get your start in an engineer's office after graduation, try to show your employer that you are interested in your work, and do not work with one eye on the clock. Nothing gives a worse impression of a young man's capabilities than a want of keenness in his work. Again, a young college graduate will often find himself in receipt of pay a good deal below that of some of his colleagues whose scientfic attainments are much inferior to his own, yet whose ability to get out rapidly detail drawings for the shops makes them for the time being the more valuable men in the office. The technical school man is, in fact, handicapped on his first entrance into the drawing office by his want of practice in the routine work of an office, and he must not expect to earn so much for the first few years as the men who have spent the years at the drawing board which he has spent at college. He must do his best to make up for lost time in this respect, and have patience to wait for the opportunity which is sure to come in time, when his special training will bring him to the front.

Acquirement of Foreign Languages.

You will find that a thorough acquaintance with a foreign language is a very useful thing to have. If I may introduce for a moment a personal note, I will tell you of an experience of my own. When I was an apprentice I read a speech by Robert Lowe, then Chancellor of the Exchequer, in which he strongly advised young men to acquire thoroughly the French language by reading French literature and French newspapers. I made up my mind to try and do so, and I owe to this my first opportunity for promotion, as I had only been a few months in Messrs. Thornycroft's drawing office when someone was needed to go to Cherbourg to run the trials of some torpedo boats. The man whose business it was to do this was needed elsewhere, and my knowledge of French helped to secure my selection.

Press and Society Contributions.

A student or young associate member of engineering institutions may make a useful addition to his pocket-money by contributing to the proceedings abstracts from the technical press of foreign countries with the language of which he may be familiar. Besides keeping him abreast of what is being done in other countries, this is excellent practice in composition. There are many men with a thorough knowledge of their particular subject who are unable to write about it in good English, and are severely handicapped in consequence.

Do not seek to specialise too soon. You can never tell in which direction an opening may appear for you. Be just an engineer ready to turn your hand to anything within your scope, and my advice to you is not to expect to jump right into the berth for which you consider yourself to be the best suited as soon as you graduate. Take what offers so long as it is something into which you can throw a whole-hearted energy. It is always easier to get a better berth when you already have something than it is to find one when you need it badly. I am not advising you to be a rolling stone, because rolling stones generally roll downhill, but the great thing is to get going, jump on to the train somewhere, if it is only in the third-class, and trust to being able to get along to a more comfortable seat afterwards.

OIL AS A SUBSTITUTE FOR COAL.

THE recent coal strikes in Germany have had the result of intensifying public interest in that country on the question of substitutes for coal. In many industrial works requiring a large amount of coal, says the British Consul-General for Westphalia and the Rhenish Provinces, steam engines have of late years been partly replaced by engines worked with benzol and oils of various kinds. As coals become more expensive, technical improvements in oil engines are being made, which will in time cause the use of coal to decrease. Oils of all kinds, particularly petroleum, says the consul-general suggest themselves as substitutes for coal. Of late, the Diesel engine has attracted a great amount of attention, and in connection therewith, the improvements in the process of obtaining oils from coal. It is only quite recently that the difficulties experienced with these oils have been overcome. Since the last coal strike, many firms have turned to oil in order to lessen the danger of running short of coal, and many firms have made slight alterations in portions of their furnaces in order to be able to burn oil fuel in case of such an emergency. Coal-tar oil promises to have a great future as a general fuel.

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FEED WATER HEATERS.

THE very general tendency toward the use of the open feed-water heater during recent years is a logical result of the many satisfactory features inherent in its design, states an American contemporary. The practical elimination of the necessity for frequent cleaning, the ease with which deposits of scale and mud can be removed, the limited opportunity for breakdowns and the lack of necessity for repairs, together with high operating efficiency, all contribute to the favor with which it is regarded, and make it a thoroughly desirable and even necessary piece of apparatus for every power plant. It is, however, subject under certain conditions to become "air bound." When this condition arises, the heater simply fails to deliver hot feed water although everything about it is working satisfactorily.

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BOILER SETTINGS.

WRITING in the Electrical Review on "Boiler Settings," Mr. Edward Ingham points out that a boiler will often work satisfactorily even when the flues are cramped and restricted, so long as it is only required to work at comparatively low power. When, however, extensions of the steam plant are made, and the boiler is called upon to develop its full power, it is unable to do so. The results of this may be very serious, for it is generally a difficult matter to remedy the evil; hence the importance of building the flues of ample capacity in the first instance. In Lancashire boilers, a mistake sometimes made is to build the fire-bridges too high. Such a mistake is liable seriously to cripple the draught, and in one or two instances which have come under the writer's notice it has been impossible to maintain steam in consequence. The removal of one or two layers of brick has entirely remedied the evil. Generally speaking, a distance of not less than 10 in. should be left between the tops of the bridges and the furnace crowns at the middle.

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WIRELESS TRANSMISSION OF POWER.

ONLY those engineers who are possessed of such a deep-rooted conservatism that they cannot believe in the possibility of anything which has not been actually accomplished will decline to support Nikola Tesla in his belief that sooner or later the wireless transmission of power will be achieved. Mr. Tesla has for long been examining the difficulties with which the problem is so strongly hedged, and in a recent article in an American contemporary, he advanced a somewhat startling proposition bearing on present-day wireless work, and put forward iconoclastic views which seem likely to cause a warm discussion.

In the early part of his article, Tesla touches upon the scheme which he described before the National Electric Light Association in 1893. It was an extension of his system of transmission through a single wire without a return, and if his ideas were rational, energy could be transmitted to any part of the world. This scheme involved the production of powerful electrical vibrations, but the important question which required answering was, how would the earth be affected by the oscillation impressed upon it? The earth and its conducting envelope would appear to have a great capacity—so great, indeed, as to preclude the possibility of economic transmission to distances of commercial importance. Moreover, he found in his experiments that currents of high frequency and potential passed freely through air moderately rarefied, and that the currents in the wire caused a considerable loss of energy in the surrounding air. It seemed, therefore, a logical deduction that a similar waste might occur in the earth's atmosphere.

The Earth Not a Capacity Conductor.

Tesla asserts, however, that he has positively established that the earth does not act like a conductor of immense capacity, and that the loss of energy due to absorption in the air is insignificant. He required them to establish the laws which govern the transmission of these currents, for until these were settled little progress in economic power transmission was possible. In 1899, he relates, he came up against what appeared to be an insuperable difficulty which at one time filled him with apprehension that transmission of power without wires would never be practicable. This was the waste of energy in daytime such as is now met in wireless telegraphy, and which present theory attributes to the ionisation of the atmosphere by the sun's rays. In this manner, the energy of the waves is, according to the theory, absorbed by the electrons freed by the sunlight. This, says Tesla, is ingenious but fine-spun, and he develops a new theory to account for this phenomenon. He points out that in the Hertz wave system of telegraphy, which is designed on the understanding that messages are transmitted by Hertzian waves in the ether, there is no free earth connection. The transmitter and receiver are separated from the earth by spark gaps, choking coils, and resistances, which are a necessity to secure a maximum intensity of radiation. In Tesla's own system, there is a direct connection to earth in both transmitter and receiver. In the former case the receiver is affected by rays traversing the ether, conduction being excluded, and in the latter instance there is no appreciable radiation, and the receiver is energised by currents conducted through the earth, while an equivalent electric displacement occurs in the atmosphere.

Error in Present Theory.

Just here, says Tesla, there exists an error in our present theory which requires immediate investigation. He asserts that in the present day wireless apparatus the frequency has been so lowered that the Hertzian effect is almost absent, and the energy is transmitted chiefly, if not wholly, by conduction. This can be demonstrated in several ways. One is to replace the vertical transmitting wire by a horizontal one of the same effective capacity, when the action of the receiver is as distinct as before. Another point in the evidence is that quantitative measurements prove that the energy does not diminish as the square of the distance as it should do, since Hertzian waves are propagated in a hemisphere. Moreover, when the ground connection is broken the receiver fails to respond—at least, for great distances. The plain fact, says Tesla, is that the Hertzian

waves emitted from the aerial are just as much a loss of power as the short radiation of heat due to frictional waste in the wire. The contention that both radiation and conduction may be utilised in actuating the receiver is, he declares, untenable. If messages across the Atlantic were transmitted by Hertzian waves, they would take 0.016 second, whereas the actual time taken by the current is 0.0006 second.

Wave Length a Factor.

Assuming, then, that the receiver is operated by earth currents, the weakening of the impulses observed in daytime is not to be explained by atmospheric changes. They must be traced to an effect interfering with the transmission of the current through the superficial layers of the globe. True, the solar radiations are the cause of the weakening, but it is not the light waves, declares Tesla; it is the heat waves. In his opinion the loss of energy arises from the evaporation of the water on that side of the earth presented to the sun, the conducting particles carrying off more or less of the electrical charges imparted to the ground. His investigations have led him to the conclusion that the waste of energy is proportional to the square of the electric density induced by the transmitter at the earth's surface and the frequency of the currents; but since the surface density increases as the frequency, the loss is proportional to the cube of the frequency. With waves 300 metres long, economic transmission of energy would be out of the question, owing to the great loss; but with 12,000 metres wave length, the loss becomes insignificant, and on this fortunate fact, says Tesla, the future of wireless transmission of energy rests.

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CANADIAN TRADE.

CORRECTED customs for the year ending March 31, 1912, show that the aggregate foreign trade of Canada was $874,637,794, made up of exports of $315,317,250, and imports of $559,320,544. The total duty collected was $87,576,036, as compared with $73,312,367 in 1910.

Exports.

The United Kingdom was the best customer of Canada, taking $151,853,413 of her exports. The United States took $120,534,634. Other countries to which Canadian goods were exported were:— West Indies, $6,900,940; South America, $4,825,030; Newfoundland, $4,284,313; Australia, $3,947,015; Germany, $3,814,914; Belgium, $3,732,222; France, $2,123,705.

Imports.

Canada bought most heavily from the United States, her imports from that country being 356,354,478; those from Great Britain were $116,907,022, while those from other countries were:— France, $11,744,664; Germany, $11,090,005; South America, $10,533,310; West Indies, $8,490,878; Switzerland, $3,458,006; Belgium, $3,686,419; China and Japan, $3,112,982 . Of the duty collected $49,177,584 came from the United States and $22,367,069 from Great Britain. The percentage of duty on all goods imported for consumption was 16.

Provincial Record.

The trade was divided among the provinces as follows:—

Provinces.	Exports.	Imports.
Ontario	$108,554,833	$240,262,151
Quebec	123,104,836	164,349,054
Nova Scotia	23,569,432	19,285,187
New Brunswick	28,979,547	11,953,742
Manitoba	3,302,815	44,223,896
British Columbia	20,272,840	49,345,161
P. E. Island	583,211	703,269
Alberta	52,685	13,878,838
Saskatchewan	4,621,809	14,266,969
Yukon Territory	2,275,241	952,669

Customs Revenue.

The Customs revenue was derived from the several provinces as follows:—

Ontario	$34,326,700
Quebec	23,047,221
New Brunswick	1,842,036
Nova Scotia	3,074,663
Manitoba	8,781,843
British Columbia	10,612,828
Prince Edward Island	130,604
Alberta	3,137,456
Saskatchewan	2,452,052
Yukon Territory	163,338

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WHY DO BUSINESS MEN FAIL?

By W. C. Holman.

ACCORDING to the report of Bradstreet's, 12,646 failures occurred in the United States during 1911, and of this number 3,414 were directly attributable to incompetence. The percentage due to the various causes is tabulated as follows:—

Lack of capital	31.4
Incompetence	27.0
Specific conditions	16.9
Fraud	10.6
Inexperience	41.1
Competition	2.9
Neglect	2.2
Unwise credits	2.0
Failures of others	1.3
Extravagance	.9
Speculation	.7

There is a world of difference between the plus salesman and the minus salesman. The plus salesman is always bringing reasons to bear why a prospect should buy, and he gets plus business; the minus salesman is busy removing reasons why his customers think they should not buy, and he gets minus business.

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THE MAKING OF GOOD WORKMEN.

By J. T. Towlson.

THERE is no doubt that good workmen of the kind known as such twenty years ago are now far from being common in our shops at the present day. There are certain reasons for this, with which this article will have small mention. The question of the workmen's and the apprentices' own responsibility is a matter I would like to deal with frankly.

The man who lives in the office cannot be expected to voice or even possess the same opinions as he who lives in the shops. Who possesses the clearer view of the disabilities and the responsibilities of the workmen and the apprentices it is difficult to say; for there is no doubt that the opinions of both are essential to a fair verdict. There is nothing more easy, I think, than for one or the other, the office or the shop foreman, to form a somewhat dangerous and one-sided opinion, an opinion sometimes based on training, sometimes on self interest, and at others on clannishness and close and restricted environment. So, obviously, to arrive at serviceable facts, both sides must be taken. I take the shop side, but with a desire to be corrected if considered in error.

The Apprentice Problem.

There is some evidence in our large towns that lads will fight shy of apprenticeships, and strike out at once for positions of higher pay; but in many cases, to my own knowledge, the boys crowd to come as apprentices in our large shops, seeking no higher pay that such a condition normally brings. True, at times the influence of unwise yet ready parents is brought to bear on the lads, and for immediate gain they sacrifice a trade and leave their apprenticeship. These things will happen, and are part of the battle for a living, but bad and to be deprecated all the same, as the lads find later to their cost. The apprentice's good is the hobby, with which I side, and it is possible that during a long professional life in the shops, a voicing of the following tenets has helped some. Others may be reached with the engineering press as a vehicle, and for the aid of such this is written.

I am gratified to notice that there is a growing consensus of opinion that employers would do well to give greater attention to the technical up-bringing of those lads who have become apprentices in their works. Employers who have an honorable anxiety for the boy's future and also the future of the mechanical trades, go a long way to assist. I am in the fullest harmony with such opinion and effort, but, at the same time, I have the merest shade of excuse and palliation for those lads who fail to make the very best of their individual opportunities. It is well known that some of the ablest of our engineers and shop managers have reached their high and responsible positions without the aid of

outside and orthodox technical instruction, simply by their persistent plodding as home students. I am afraid—in fact, I know—that too much dependence is placed on the result of the continuation school and university teaching, with the effect that the boy's own and valuable traits and natural faculties do not get their free-est play.

It must be admitted, especially to-day, that in many shops the particular abilities of the ablest and most assiduous apprentices are exploited for the benefit of the employer and the employer's clients. In the rush for dividends, every consideration of what is due to the lad, every honest consideration for the lad's future is broken down. Not with interest perhaps, and, maybe, not from heartlessness; but much evil is done for want of thought. The unvarnished fact stands thus:— Young lads found particularly expert on certain work—and especially on jobs tendered for with apprentices' rates as a basis—are kept to that job, not for a week, a month, but for years. Now, if this is true, 'tis a shame, and all the lad can do is to fight against the tendency which threatens to keep him down. It is the lad's province and his own particular responsibility to see to it, and by his own personal pluck and assiduity, and outside his shop disabilities, to seek and pursue his own personal improvement.

Love of One's Profession.

If he desires to excel as a mechanic or, further, as an all-round engineer, he will do this; he will read and study for the love of it. He will explore the thrilling and absorbing problems of the profession as a solid and returnable recreation. Some may say, "after a hard day's work we want a rest." Again, I say that for the lad who wants to get on it is a rest and a recreation from uncongenial work, such as has been indicated, to search and discover, to master and subserve "the why and the wherefore" of things engineering, which are a dead language to many—in fact, the majority of mechanics.

The Reward of Study.

I cannot agree with the youth who says, "Supposing I do learn this and master that, how much better off shall I financially be? We cannot all be foremen, managers, and, moreover, the difference between the best paid workmen and the worst is only a halfpenny per hour." All this is true, and will have to be remedied—men being paid according to their merit and value—but I have no patience with such thoughtless objection, for it is obvious that if that line is followed we attack the bedrock of individual education in all forms, and preach a doctrine fatal to individual merit and excellence. I am afraid that the origin of the contention lies in want of interest, or worse, laziness; for if we pretend to be mechanics, or, for the matter of that, artisans of any cult or profession, is it not one of the honorable and durable satisfactions of life to know that what one has attempted one has done, to know that we have excelled in that which we have essayed? And if he excels in his chosen profession, is there not something about such a condition which is pleasing to his senses? And is not this tangible excellence a useful and negotiable asset? The mechanic goes to work to earn the wherewithal to purchase his living, his food and luxuries. He likes to subserve for himself, and if he desires a change he has the prerogative of being the initiator of such a change to leave a shop if he chooses, and not to be discharged.

We shop managers know instinctively the men whom we can ill spare from our shops, and also those who when absent are hardly missed, and who are bound "to go" in slack time. We do not discharge the ones whom we value, for their service is always equal to and sometimes surpasses the wages paid them. Another point of durable satisfaction to the apprentice out of his time, who has done his part during his apprenticeship, is that on taking a job in a strange shop he never need fear what job may be given him to do. He will be equal to the next man, and be able to give evidence of that the first day he is set to work.

Apprentice Education.

May I say that the education of an apprentice should begin the first day he enters a shop, and it cannot be too too strongly emphasized that the education referred to is not merely the learning perfunctorily obtained by certain lessons at specified times, but the training of the hand, the eye, and the judgment, the gradual development of the sense of proportion, the peculiarly valuable ability to apportion to each detail its proper value, to be able to develop the qualities of self-reliance, pluck and determination to surmount difficulties. Without these acquirements notwithstanding abundance of learning, he would be at a disadvantage wherever placed. In the words of the German philosopher, Jean Paul Ritcher, "Every man has two educations—the one given him and that which he gives himself." Of the two kinds, I think the latter is by far the most endurable asset. Indeed, all that is most worthy in a man he must work out and conquer for himself, for it is that which constitutes his best nourishment.

That is why I insist that he who would secure for himself the satisfaction referred to must ceaselessly pursue, as a part of his nature, the desired excellence I have named. I do not pin my advice in favor of school training, though that is an essential to success, nor do I advise or impress the need of a familiarity with the practical side of engineering and mechanics more than the theoretical side. That which I know to be of great value, however, is a consistent blending of both. There is not that conflict between one and the other, i.e., theory and practice, as is too often imagined. Added to these I commend persistent work, and as a helpful corollary (as Shakespeare puts it) "the purest treasure mortal times afford a spotless reputation." — The Practical Engineer."

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PARS FROM CURRENT LITERATURE

Castor Oil.—A few years ago castor oil was the universal lubricant in India for both internal and external lubrication, but as engineers became more enlightened on the subject generally, castor oil for internal lubrication was discarded. The principle reason why castor oil has been condemned for internal lubrication is the breaking up of the oil into several corroding acids when exposed to high temperatures. As a lubricant for external bearings, however, castor oil is still largely used, and the old school of mechanical engineers will not listen to anything against it. A temperature test, however, will very soon show that, owing to the high fluid friction of castor oil, the running temperature of a bearing lubricated with a hydro-carbon oil will be considerably lower than that with castor oil.

* * *

Welded Lap Joints.—In some tests carried out in Germany on welded lap joints in boiler plates, two hand-welded joints were made, one being carefully worked at the right heat and the other being overheated. Tests were then carried out on numerous specimens cut from the plates, so as to include the joints, and either side. Half the test pieces were annealed before testing, their elastic limit and ultimate strength being lowered thereby. This indicates that the unannealed plates were considerably hardened by over-straining during welding, and annealing relieves the internal stresses. The detrimental effects of burning were very slight. On an average, the strength of a test piece containing the joint was 0.99 of that of the plain plate annealed, and 0.98 unannealed. The proportion for the elastic limit was between 0.85 and 0.98. It was concluded that the ratio of strength of joint to that of plate may safely be assumed to be 0.8, instead of 0.7 as specified in the German regulations.

Dust Explosions.—The amount of coal dust necessary to transmit a dust explosion is about one gramme per cubic metre of air. Such a quantity is frequently found, especially where high speed haulage is used. The most direct way of obtaining safety is by preventing its formation, and this can be done at the start by the use, for example, of hydraulic power to bring down the coal wet, and by enclosing tubs as thoroughly as possible. It can be removed to some extent by brushing, or, much better, by a fan collector. It can also be kept down by sprinkling with water, or, a more recent suggestion, by the use of a binder, such as soap or caustic soda with water. In a mine with the coal dust either removed or fixed, the danger of a local ignition of gas spreading through the workings would be entirely removed. This would not, of course, lower the standard of electrical plant, for all the conditions which apply to safety against ignition extend to prevention of shock.

* * *

Cleaning Boiler Flues.—The question of cleaning boiler flues mechanically appears to be receiving attention in various quarters. Two installations of vacuum plant have been tried for cleaning the flues of Lancashire boilers. In these, the men go inside the flues and manipulate a nozzle attached to a flexible pipe. Again in some cases it might be possible to work the pipe from the outside by providing special doors in the brickwork of the flues. Experiments are being made by one firm in this direction, and doubtless if any demand is created for such plants they will be greatly improved.

* * *

Starting Up Economisers.—It has recently been pointed out that accidents occasionally occur during the operation of starting up an economiser early in the morning. A careless attendant, for instance, on starting will sometimes open to the full, the dampers in the economiser chamber, and so allow the whole of the hot flue gas to pass through the chamber, forgetting for the moment that the engines or turbines and the feed pumps have not yet been started up and that there is consequently no water flowing through the economiser. Under these circumstances, the enclosed water becomes heated, until eventually evaporation into steam commences. The level of the water in the vertical pipes then becomes gradually lowered, with the result that the upper portion of the pipes, being bared of water, suffer from more or less overheating. Further, the steam so formed, by coming into contact with the water on the boiler side of the outlet valve, when the latter is opened, tends to cause "water hammer" action. This "water hammer" action causes cracking in the pipes, and it has in some instances led to fracture and explosion and serious injury to the engineer-in-charge.

* * *

Economiser Explosions.—The idea that an economiser is safe from explosion because it is only exposed to water pressure is probably due to the fact that vessels which have to be worked under steam or air pressure are invariably tested by means of water. The reason for so doing is that danger is eliminated of the parts flying violently asunder should any part fail,as would happen if steam or air were employed. There is, however, a great difference between an economiser under pressure and a steam boiler or other vessel under cold water pressure. In the latter case, in the event of any part of the structure failing, the pressure is instantly relieved, with very little increase in the volume of the fluid, and no great harm is done; in the former case much of the water in the economiser is usually at a temperature much greater than 212 deg. Fah., so that should the pressure be suddenly relieved due to failure of the containing vessel, a portion of the water would immediately flash into steam, the accompanying violent expansive force of which may cause entire disruption of the economiser.

* * *

Steam Pipe Expansion.—While the necessity of providing for expansion in long ranges of steam pipes is generally recognized, steam users sometimes overlook the importance, where such an expansion arrangement consists of a stuffing-box device and the ends of the length of piping are not anchored fast, of providing guard bolts to prevent the two parts being drawn asunder. The danger arising from the absence of such a provision is drawn attention to in Vulcan, and a failure is mentioned which occurred at a tinplate works a few months ago. There was a short length of pipe between the engine stop valve and the steam main leading to the boilers. The steam main and the short length were each fitted with a stuffing-box arrangement, but while that in the main was furnished with guard bolts, the short branch piece was not so provided, and when the pipes were put into operation, the two parts of the short length were drawn asunder, allowing steam to escape and scalding a laborer who was assisting on the job.

* * *

Heat Value Specifications. — In consequence of the increasing use of heat-value specifications in buying and selling coal in the United States, a demand has arisen for similar specifications to govern the purchase of fuel oils, and the Bureau of Mines has issued a pamphlet on the subject. "These specifications, to be satisfactory," says the author, "should establish not only the heating value of the oil, and thus show, like the specifications for coal, the number of heat units the purchaser obtains for a given price per unit quantity of fuel, but also the physical character of the oil, its flash-point and burning-point, and the quantity of extraneous matter it contains." The specific gravity of fuel oil, it is stated, should range from 0.85 to 0.96 at 15 deg. Cent., and the oil should be rejected if its specific gravity is above 0.97 at that temperature. It should be mobile, free from solid or semi-solid bodies, and should flow readily at ordinary atmospheric temperatures and under a head of 1 ft. of oil, through a 4-in. pipe 10 ft. in length. It should not congeal nor become too sluggish to flow at 0 deg. Cent., and should have a calorific value of not less than 10,000 calories per gramme (18,000 B.Th.U. per pound); 10,150 calories to be the standard.

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POWER FOR ROLLING MILLS.

THE power required to drive a rolling mill naturally varies rapidly between wide limits. To ensure that the working costs of a rolling mill should be low, means must be found for reducing the fluctuations in the power required to drive the mill, care being taken in doing this that the capital cost of the plant is not unduly increased nor the possible output reduced.

The variations in power are reduced by employing a fly-wheel in conjunction with an electric motor which is used to drive a rolling mill, and by providing some device for reducing the speed of the motor and fly-wheel to enable the latter to give out some of its stored energy when the demand for power is great, so as to reduce the power which has to be furnished by the motor. When the demand for power is small, the motor will speed up the fly-wheel, thereby replacing its stored energy; this increases the power which the motor has to supply when the demand made by the mill is small, and therefore reduces the total variation in power.

In making the above general observations, it must be borne in mind that the character of the variations in the power required to drive the rolling mill depends on the type of the mill to be driven.

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Mr. H. E. M. Kensit, who during the past four years has been occupied in investigating and reporting on various undertakings and projects in Canada and the United States for Messrs. Smith, Kerry and Chace, of Toronto, has received an appointment with the water power branch of the Department of the Interior, Ottawa.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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THE FUEL OUTLOOK.

IT may he safely affirmed that at no previous period in the history of power generation has there heen the widespread disposition to investigate, experiment with, and develop by consistent application the adaptability of hitherto undreamt of possibilities in the fuel world. True it is that for a number of years, water power or "white fuel" has been encroaching on the domain of and wresting from coal, much of its pride of place, hut it has remained for more recent times to bear in upon us the fact that with suitably designed mechanisms and appliances, other and less apparently likely suhstances may still more seriously challenge "King Coal."

Oil and peat, as will be noted from the contents of this number, are each making much headway as competitors, the former in the capacity of hoth a direct generator of steam and as a direct effective force medium in prime movers. Peat as will be noted, is being successfully applied for gas producer purposes, and while it may be somewhat premature to say just to what extent they each will usurp the place and prominence of coal, there are not wanting many evidences of achievement, as well as of expert prediction that hoth of these rivals will yet revolutionize the power generation field. No undue haste is heing shown in the propagation of this fuel question, there heing altogether an absence of that undesirable feature of exploitation, and in the columns of this journal from month to month are to be found details of what is being done together with opinions and up-to-date conclusions from results ohtained, which will enable our readers to draw the necessary lessons therefrom and make provision accordingly.

THE C. A. S. E. EDUCATIONAL PROGRAMME.

IN our August issue we published an open letter to the members of the Canadian Association of Stationery Engineers hy the secretary, Mr. A. Kastella. Its main feature was the appointment of an educational committee to prepare a series of "Questions and Answers," by means of which to educate the general body of the members. Just how far short the scheme will come of its purpose, we don't care to prophesy, but that it will, as an educative agent, be a disappointment to its promoters, there is little room for doubt.

Education of any kind, or, at least, worth the name, must be imparted, and in addition must he digested by the pupil. Questions and answers unaccompanied hy qualified instruction and reasoning help a man to the same extent or to a little less extent, perhaps, in an emergency, as does informing him in broad daylight that your house number is 279 Robert Street, and inviting him to visit you the same evening at 9 o'clock, at which time the darkness makes necessary his approaching a half dozen verandahs in order to locate the number. There is surely available in many of the localities where lodges exist, an instructor, member or otherwise, who would undertake the duties, and who would even for an unattractive remuneration, he willing to give an evening or two in return for the educative results that would accrue to himself.

Text books and technical papers are within the reach of every engineer to possess, and it will be found that in large part, questions and answers to serve a man his lifetime are there on tap. Questions and answers contribute more to indolence of reasoning and consequently to helplessness in trouble than do perhaps any other "easy" method of acquiring knowledge, and while we are in entire sympathy with the spirit of the effort heing made to improve the educational standing of operative engineers, we regret that something more effective was not planned in preference.

THE PLACE OF TRADE JOURNALS.

IN another part of the present issue will be found an article entitled the "Educational Value of Engineering Magazines," and to The Power House subscribers in every department of the field covered by our medium, we commend a careful perusal of what the writer has noted as outstanding features. We are afraid that readers of trade journals generally are not sufficiently alive to the service heing rendered and the benefits derivable from a close and intelligent study of the contents of the particular periodical to which they suhscribe, and through which they are enabled to keep abreast of the times on a competitive basis. There is too much of a tendency to rest content with the receipt of the magazine and to give it but a cursory glance in the hope, perchance, that some strongly developed headline may attract and awaken interest.

There is much of value, hoth from an editorial and advertising standpoint in the least effective of the many trade journals, and the same conclusion may he arrived at relative to even an admittedly weak issue of the very highest grade papers. In no other way, and certainly hy no more effective means can a man, stirred with the ambition to get ahead in his calling, secure that broadness of idea and keep in intimate touch with world-wide development than hy digesting the contents of the magazines pertaining to his profession as they appear regularly. The cost is infinitessimal compared to the value received, and in no other department of our complex relationship to one another is there the nearest approach to that commonly apparent yet most often unattainahle ideal of acquiring "something for nothing." To operating engineers particularly, in view of the advent of the season of long evenings and their opportunity for self improvement, we would commend a hearty display of the study feature relative to your particular and specialized professional paper contents.

GAS AND OIL ENGINE PROGRESS

A record of principles of design, construction and achievement in a rapidly developing sphere of power generation.

OIL FUEL FOR INDUSTRIAL PURPOSES.

THE progress made on the sea by oil has been so rapid that, except for railways, its uses on land seem to have been almost forgotten or overlooked. Of course it has been recognized that in oil centres such as California, it is used in factories to the exclusion of coal, and also in Russia to some extent, although to what extent, the public has no idea, and contents itself with repeating that "the old ways will suit us for years to come. It was a remark made by a late chairman of the London General Omnibus Co. in regard to the use of horses when the Vanguard busses first came on the street, six years ago., but all the horses have gone now, and the propheey has been falsified.

The Future Outlook.

All the same, people go on saying coal will be our mainstay for a long while yet, for how can oil which is not at our doors compete with coal which is? Well, it can and it begins to do so. The chief hindrance is that oil in this country for the moment is in the hands of two or three big concerns, who charge whatever prices they like, and are able to do so, owing to the fact that there are not ships enough to bring competing cargoes. Time—and not a long time even; will alter all that, and what then? As soon as this happens there will be a great increase in the consumption of residual oil for manufacturing purposes.

Mark what has taken place. At the beginning of the 19th century, when all Europe was at last reduced to peace, we through the proximity of our natural resources and fruitfulness in invention captured the first place in the trade of the world, and have held it for nearly a century. The comfort of a fat living checked the inventive faculty, and other nations took pride of place as inventors, being forced by pressure of events to find labor saving appliances, the need of which we did not feel. As they progress commercially, we in turn feel their pressure and the faculty begins to return.

Necessity, that fecund mother, is called upon to bear children, and again responds to the call. Thus in the heart of our coal and iron district is born an oil furnace, bringing into use the burner of old Bunsen, which produces an intensity of heat by a simplicity of method, with an economy of cost, which bids fair to revolutionise many industries. Already, certain manufacturers find that by means of it, they can do the work of thirty men with the aid of one, and already the glass bottle trade by its use begins to return to the country.

Oil Fuel in General Use.

Already the biscuit princes of the country are installing it in their factories, and a long list of applicants await the delivery of their orders. It is used by steel makers, tube drawers, glass makers, and for china burning, roasting of ores, calcining lime, manufacture of cements, melting, armor plate making, etc., etc. The invention is the work of two men whose labors would read like those of Palissy—a real Samuel Smiles, self-help tale, whose only barrier to advance is want of sufficient capital to finance their orders, and the difficulty of obtaining enough oil at present to supply their customers.

The system is not alone in the world—other countries have been before us and if it were, it would soon have rivals, but what interests us is, that it seems to make a long step in the advance of oil as a fuel on land, and, further, that it must have the effect of distributing industries more widely over the country. No longer must it be necessary for the steelmaker to live in a grimy city, where the foulness of smoke pollutes the freshness of the air, and the sordidness of surroundings debases the moral character. The cleanness of Pittsburg will be the lot of other centres, and haply the Smoke Abatement Society find less opportunity for its labors.

A long way off, all this, but big oaks from little acorns grow, and those who have the keenness of vision to see into the future—the Cowdrays and Furnesses—are already girding up their loins to get a share of the spoils, building argosies to carry oil to these shores. —The foregoing is from the H. S. Stoneham, London, Weekly Statement.

OIL FUEL ON THE MEXICAN RAILWAY.

THE whole of the Mexican railway locomotives have now been fitted with oil burners, and such difficulties as arose with regard to the drivers and firemen have been completely got over. It appears that when oil was first introduced, every possible difficulty was put in the way by the English and Scotch drivers, most of whom resented the change, and in some cases refused to work the engines with oil. As regards the Mexican drivers there was less trouble. They were shown how the oil fuel should be applied, and how to work the engine under the new conditions, and to the best of their ability followed the instructions without cavil. Subsequently a curious position was developed. There was a difficulty in the oil supply, and many of the engines had to be reconverted and again fired with coal. The Scotsmen in particular, who had been most conspicuous in their obstinate resistance to the use of oil, made louder lamentations over the resumption of coal than any other section of drivers. However, all that is now done with, and the new system works exceedingly well in every respect, and is regarded by the whole staff as an immense improvement on the coal burning method.

With regard to the economies effected by this change of fuel, it may be said that the management do not by any means regard the existing arrangements as the end of the advantages to be derived. Further developments in the way of organization are under discussion, and further substantial reductions in the cost of haulage are hoped for in the future.

FUEL FOR PRODUCERS AND INTERNAL COMBUSTION ENGINES.

IN answer to a constantly increasing demand for information concerning the internal combustion engine and the gas producer, the United States Bureau of Mines has issued Technical Paper No. 9, The Status of the Gas Producer and of the Internal-Combustion Engine in the Utilization of Fuels. Robert H. Fernald, the consulting engineer of the

Bureau on gas producer practice, who is the author of the paper, has the following to say in the introduction:—

Vitality of the Gas Producer.

Investigations into the possibility of generating producer gas for power purposes in a commercial way from the various mineral fuels of the country has been carried on for some time by the United States Government. These investigations have been associated with steaming, briquetting, coking and other tests, all of which supplemented an examination into the nature, extent and distribution of the fuels used. The tests have been made with carefully selected representative samples and carload lots of coal, lignite, etc., procured especially for the purpose by experienced collectors. In New England, for example, marked economies can be gained by a general use of the gas producer, and moreover these economies would be sufficient to overcome the handicap placed on industries there by the transportation charges on coal. The development of power in the New England States through the efficient method suggested by these investigations would mean a yearly saving of many millions of dollars.

Many States of the West that have no good coal are also greatly benefited by the investigations, which have shown the adaptability of the gas producer for the utilization of low-grade coal, lignite, peat, etc. As mined, these fuels can not be used in boiler furnaces and will not bear long transportation, but the gas producer makes them of potential value. Thus the gas producer is an agency of conservation. It helps to keep the low-grade coals from being permanently lost by being left in the mines in such condition as to make their future recovery impossible. In States in which deposits of low-grade coal, lignite and peat are found, the present cost of power, as developed in steam plants with coal that has been shipped a considerable distance, can be materially reduced by placing producer plants at the mines or bogs, so as to utilize these low-grade fuels without cost of shipment by generating electric current which can be easily transmitted to desired points within a wide radius.

Gas Producer Tests.

The tests in the gas producer have shown that many fuels of so low grade as to be practically valueless for steaming purposes, such as slack coal, bone coal and lignite, may be economically converted into producer gas and may thus generate sufficient power to render them of high commercial value. It is estimated that, on an average, each coal tested in the producer-gas plant developed two and one-half times the power that it would develop in the ordinary steam-boiler plant. It was found that the low-grade lignite of North Dakota developed as much power when converted into producer gas as did the best West Virginia bituminous coals burned under the steam boiler.

Wastes of Coal in Mining.

Investigation into the waste of coal in mining has shown that it probably aggregates 250,000,000 to 300,000,000 tons yearly, of which at least one-half might be saved. It has been demonstrated that the low-grade coals, high in sulphur and ash, now left underground, can be used economically in the gas producer for the ultimate production of power, heat and light, and should, therefore, be mined at the same time as the high-grade coal.

In line with this conservation of fuel resources, it is interesting to note that one estimate states that the United States Steel Corporation alone, through installations of blast-furnace gas engines to displace the old equipment, saves approximately 1,000,000 tons of coal per annum. The investigations also show that the general use of gas producers for the development of power means the elimination practically of the smoke nuisance. This result is especially important in cities that are compelled to use bituminous coals.

Gas Producer Smokeless.

The great saving in fuel obtained through the gas producer has led to the installation within the last decade of several hundred of these power plants throughout the United States. These producer plants are practically smokeless during operation. As a smoke preventer, the gas producer is one of the most efficient devices on the market, and furthermore, it reduces the fuel consumption not 10 or 15 per cent., as claimed for the ordinary smoke preventing device offered for use in steam plants, but 50 to 60 per cent.

The establishment of producer gas plants at the mines and the distribution of electric energy or gas over large areas will also tend to eliminate smoke. When a large percentage of the small, isolated power and heating plants and all steam locomotives have been removed from the larger cities, the atmosphere of these cities will be much clearer and heavy financial losses directly traceable to smoke will be eliminated."

THE SMOKE NUISANCE AND ITS ABATEMENT.

By John Macauley.

WHEN fresh coal is thrown upon an incandescent bed, the intense heat causes the release of the volatile or gaseous constituents of the coal, which burst into luminous flames above the fire. These consist chiefly of a series of hydrocarbon compounds and play an important port in the production of heat. With an ample supply of air admitted to the furnace in fine streams so as to thoroughly intermix with the hydrocarbons at a sufficiently high temperature, these gases will burn in the upper part of the furnace with a heat producing flame, resulting in the formation of CO_2 and steam.

Soot and Smoke.

The liberation of these hydrocarbons is simply a process of evaporation; therefore, as during that process heat is absorbed and the furnace cooled to some extent, it will be understood how necessary it is to maintain a high temperature, i. e., not to allow too long an interval to elapse between the periods of firing, or, in other words, not to allow the fire to burn low. The hydrocarbons are decomposed at high temperatures, and if there is an inadequate supply of oxygen, or air, the carbon separates as soot which is not consumed. Again, should the temperature of the furnace be too low, the particles of carbon will be deposited unburnt in the form of soot, even in the presence of an excess of oxygen. The formation of visible smoke is chiefly caused by the liberation of these hydrocarbons at a low temperature or by the insufficient supply and admixture of the quantity of oxygen which is requisite for their complete combustion at the temperature of ignition.

Visible smoke, though bad, is, however, an indicator of something worse, which is generated in the furnace and emitted from the chimney in the form of the poisonous gas CO, the flame of which is readily distinguished in the fire by its well-known violet blue tint. If the conditions necessary for the proper combustion of this gas are absent, it will be emitted as CO and will result in a corresponding loss of heat and furnace efficiency. Those conditions are, as in the case of the hydrocarbons, high temperature and adequate air supply. The ignition temperature of amorphous carbon is about 700 deg. C. or 1,260 deg. F., and, if this, the minimum temperature, is maintained, with an ample air supply, the carbon will be burnt to CO_2. No excess of air or admixture of the air and gases, however effective, can remedy the failure to maintain this minimum ignition temperature within the furnace.

Effect of Air Supply.

Besides the effect of the air supply on smoke, let us consider its effect upon the economical working of the furnace. Under the most favorable conditions, as in a calorimeter, when every particle of the oxygen of the air is completely used, and there is no waste oxygen to carry heat away, 1 lb. of coal will require for its combustion 11.5 lbs. of air, equal to

150 cubic feet. In practice these conditions are unattainable, much more air being required, but the excess air may be considerably reduced by using fuel which has been previously broken into small lumps. If 1 lb. of carbon is completely burned to CO_2, it will give out about 14,500 British thermal units. while if partially burned to CO, it will give only 4,500 British thermal units, showing a loss of about 10,000 units. It is, therefore, obviously necessary, for the sake of economy, that the carbon should be thoroughly burned. The incomplete combustion of the hydrocarbon gases also causes a further loss, the carbon, as it separates out in a finely divided condition as soot, covers the heating surface of the boiler flues and acts as a non-conductor of heat.

Analysis of Gases.

The best indication of the quantity of air used per 1 lb. of coal, is that given by an analysis of the gases collected at suitable places in the flues. On analysis of the products of combustion, the following gases are likely to be found viz., CO_2, extreme figures 5 per cent. to 15 per cent., more usually 7 per cent. to 14 per cent.; free oxygen, usually 4 per cent. to 12 per cent.; CO 2.5 per cent. to 0 per cent. (in an efficiently worked furnace, nil); hydrocarbons, if existing unburnt, are a source of loss; traces of sulphur compounds; nitrogen about 79 per cent.

CO_2 Recorders.

It is now usual in up-to-date boiler plants to have CO_2 recorders installed. These recorders give a fairly accurate idea of the conditions, as to air and fuel supply, under which the furnaces are working during each hour of the day, and to that extent act as a check on the firemen. The check is a useful one, because, when the boiler has been carefully set, by regular and systematic stoking and proper air supply, the recorder will show 12 per cent. to 14 per cent. CO_2 in the flue gases, and any deviation from that will cause a corresponding irregularity of the air and fuel supply to the furnaces, which can only be accounted for by bad stoking, except when cleaning fires. With hand-firing, the best results follow from what is known as "ribbon-firing," i.e., throwing the coal along one side of the fire, the full length of the furnace, and, after a short interval, repeating the operation on the other side.

When the forced draught is produced by steam jets injudiciously placed, a waste of heat is caused and volumes of smoke are produced. A waste of heat is caused because steam, at a pressure of say 50 lbs. per sq. inch, the temperature of which is 298 deg. F., introduced into a furnace whose temperature is at a minimum of 1,300 deg. F., has a cooling action on the fire; volumes of smoke are produced because the hydrocarbons are cooled and driven off, and their mixture with the oxygen of the air at the proper temperature cannot take place. The foregoing is abstracted from a paper read recently before a conference of Sanitary Inspectors in England.

METHODS OF REFINING.

THE following information about oil refining is taken from the "Oil Age," and may be of interest:—

The oil is delivered at the refinery from the pipe line into storage tanks. The still, in a single still plant, holding about 600 barrels of crude oil, is filled by the pumps. The fires are started and kept low at first in order to allow the water to evaporate before the oil boils. When the oil reaches the boiling point, 104 degrees. Fahr., the more volatile vapours begin to pass off through the worm and condenser. Some of these vapours are so volatile that they will condense only under pressure and at low temperatures. Ordinarily they are allowed to pass off into the air or conducted back to be burned under the stills.

The first liquid to flow from the still is the crude naphtha. When 350 deg. Fahr. is reached and the density of the distillate is about 56 degrees B (0.754), the naphtha has practically all passed off, and the stillman watching the stream at the receiving head turns it into another tank. The fires are constantly increased, and from 375 degrees F. to 575 degrees F. the illuminating or burning oil passes off. Super-heated steam is now turned into the still to prevent "cracking" or burning, and the condensed oil turned into a third tank. The colour of the distillate changes to a dark yellow. This oil contains the paraffin wax, and care is used that the condenser pipes are not too cold. Otherwise the paraffin will solidify and clog the pipes. This wax oil passes off at 575 degrees F. to 650 degrees F. When this residuum in the still tests at 600 degres fire test, and from 33 degrees B. (0.87) and downward, the fires are drawn, the still is allowed to cool, and later the residuum is pumped out. The residuum is a thick fluid, sometimes semi-solid, of a dark green or brown color.

We now have four tanks with distilled products in their unpurified states. These products are next taken separately and chemically treated and purified. The crude naphtha, in its present state, is of little commercial value. It is first put into the agitator with a small amount of sulphuric acid and thoroughly mixed. The acid absorbs most of the colour from the oil. After the acid is drawn off, water in a fine spray is turned into the top of the tank and allowed to trickle down through the oil. This is called "washing," and is continued as long as any acid is found in the water coming out. A weak solution of caustic soda is introduced and mixed with the oil in the agitator. After the mixture is allowed to settle, the lye is drawn off and the oil again washed until all traces of the alkali have been removed. These processes deodorize and sweeten the oil. The naphtha is then redistilled in the steam still and separated into two parts; the lighter part to 63 degrees B. gravity is called gasolene (petrol), and the other from 63 degrees B. to 54 degrees B. gravity benzine. Some refineries make three or four divisions of the naphtha, as rhigolene, gasolene, and A. B. and C. naphtha.

Naphtha oils are tested for gravity, odour and acid impurity. Gravity determines whether the oil is to be classed as gasolene, naphtha or benzine. The odor test is determined by saturating a cloth with the oil, which on evaporating will give forth any foreign odor.

Siemens Brothers, Canadian Birkbeck Building, Toronto, report that the city of Medicine Hat has just placed a contract for the equipment of their new power house and filter plant with Messrs. Fraser & Chalmers, Ltd., Montreal. Siemens Bros. Dynamo Works, Ltd., are acting as subcontractors for the whole of the electrical machinery apparatus. This equipment consists briefly of the following items:—

2—"Rateau" Steam Turbines 3600 RPM.

2—Three Phase Turbo-generators each 750 KVA, 3600 RPM.

1—"Terry" Steam Turbine 2600 RPM.

1—D.C. Turbo-Exciter 35 KW, 2600 RPM.

Complete Condensing Plant.

1—Motor driven Exciter Set 50 KW.

1—Main Switchboard, 2200 Volt with Generator, Exciter and Feeder Panels.

3—100 KVA Transformers, 2200—110-220 Volts.

3—50 KVA Transformers, 2200—110-220 Volts

2—325 HP, 1200 RPM Motor, driven high lift Centrifugal Pumps.

1—Pump Motor Switchboard.

Auxiliary Motor Equipment.

1—Switchboard for Equipment.

Lead covered cable connections between various parts of the plant.

The Steam Turbines and Condensing Plant will be manufactured at Fraser & Chalmers Works, Erith, England, and the Electrical Equipment at Siemens Works, Stafford, England. The whole of the above equipment is being supplied in accordance with specifications prepared by Mr. R. S. Lea, Montreal, who is acting as consulting engineer.

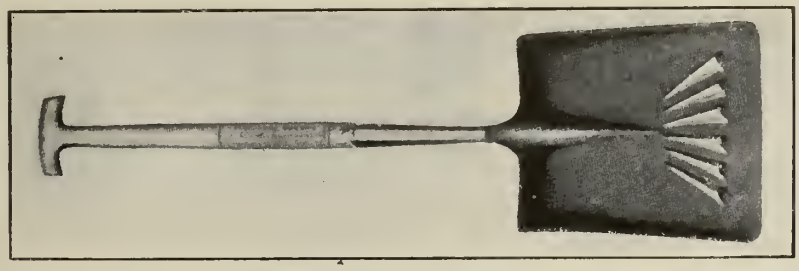
THE READERS' POINT OF VIEW

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

IMPROVED HAND FIRING.

By A. J. S.

THE difficulty with regard to hand firing in connection with ordinary steam boilers has always been that of training the fireman to distribute his coal in a uniform manner over the fire grate. In recent times, with the extensive introduction of small coal and slack for boiler purposes, the necessity for keeping a thin even and uniform bed of fire on the bars has been increasingly felt, and, owing to the difficulty in getting firemen to maintain this type of fire bed, especially when they have been used to the heavy long-period thick-fired type of stoking which was the best practice with large lumps of coal, the mechanical stoker has come into prominence.



A SPRINKLING SHOVEL.

Although the mechanical stoker has proved of immense value in dealing with cheap grades of fuel so as to produce a minimum quantity of smoke and a maximum amount of steam by sprinkling the fuel thinly over the fire, allowing it to burn equally, and preventing it from caking into a solid mass, the initial expense has in some cases been an obstacle to its adoption, and, therefore, any device which tends to produce the same result with ordinary hand firing is worthy of attention.

Defects of Hand Firing.

It is easy to see that with ordinary hand firing, the fuel leaves the shovel in a thick mass, requiring many shovelsful to cover the whole surface of the fire. The result is that the fire is covered with a thick layer of green fuel, which cools down the furnace and retards the admission of air, just at the time when the maximum amount is required for the complete combustion of the gases which are given off. For this reason, it is found in hand firing that an extra air supply has to be given from another source, usually over the top of the bars, and if this source is not shut off as the fuel burns away, waste occurs, and the cooling action of the top air on the surfaces of the boiler itself is apparent. Moreover, if no supply of air be allowed to go into the furnace except through the fuel beds when burning bituminous coal, the result is imperfect combustion and the formation of a large amount of smoke. The greatest waste from heavy firing is the resultant low temperature of the fire reducing the temperature difference between the fire and water in the boiler, and thus reducing the heat transmission.

A Sprinkling Shovel.

Mr. C. A. Fell, engineer, Sheffield, England, has specialized in the subject of fuel economy and has developed a type of sprinkling shovel which is shown in the figure. By means of the fan-shaped projection on the firing surface of the shovel, the fuel is spread so finely over the fire that the gas is driven off suddenly and ignites very quickly. In this way, the furnace temperature is kept up to a maximum and so far from an extra supply of air being necessary, the draught may be lessened by partly closing a damper. The shovel is designed to get a similar effect as with a mechanical stoker of the sprinkling type and thus the amount of steam generated in the boiler is increased by the sprinkling action without the necessity of going to the high first cost of the mechanical stoker. This is particularly advantageous in districts where manual labor for stoking is cheap, while the cost of buying, transporting and erecting a mechanical stoker would be correspondingly heavy.

It may be argued that the fire needs firing oftener, and, therefore, the fire door has to be opened oftener, but the door is not kept open for such long intervals at a time owing to a less number of shovelsful being necessary to cover the fire. Further, owing to the thin layer of fire used, it is not necessary to open the fire doors so often for raking, slicing, and poking. Again, as less draught is necessary, there is obviously a less quantity of excess air drawn through the flue when the fire door is opened, and, therefore, the boiler and its setting is not cooled down to such an extent during the firing and raking operations.

This simple modification of the ordinary firing shovel is a distinct step in the direction of boiler economy, and has the additional advantage of training the fireman automatically in the production of a high rate of steaming.

EMERGENCY REPAIR TO BOILER FEED PUMP.

By Frank Rose.

ABOUT two years ago, I had some trouble with a boiler feed pump, and feeling that this might help or at least be interesting to some reader, I am sending it for publication.

The pump was of the vertical double acting type, and after some changes in our piping and a slight increase in boiler pressure, due to a change from coal to oil fuel, it refused to deliver against a head a trifle greater than what it had previously operated. After trying various experiments so as to locate the real cause, I came to the conclusion that the seats on the delivery end might be leaking just enough to make the trouble. We were located on a suction dredge, far from any machine shop, and the job was up to us to

perform with the limited appliances for doing the work at our command—the usual wrenches and a few files, more or less the worse for hard service. I accomplished the job successfully in the following manner:—

After removing the top plate cover and taking out the top plate containing the poppet valves—this had flat seats slightly raised from its surface, I used a bastard file and filed these seats on the plate until they showed bright across their face. I next removed the stems or studs from the valves or poppets, and rubbed the seats of the poppets on the file so as not to remove any more stock than was necessary and left them just bright and fair. Taking some broken glass and pounding it fine, I ground two of the poppets together, adding oil so that the glass would cut well without leaving deep scratches.

When the marks of the file were about half removed or ground out, I did likewise with the other two poppets, after which I set them in their proper seats and ground them to a nice bearing, taking out all signs of file marks. After cleaning the glass from all the parts thoroughly, I put the plate back on the pump, put on the case, tested out, and found no further trouble.

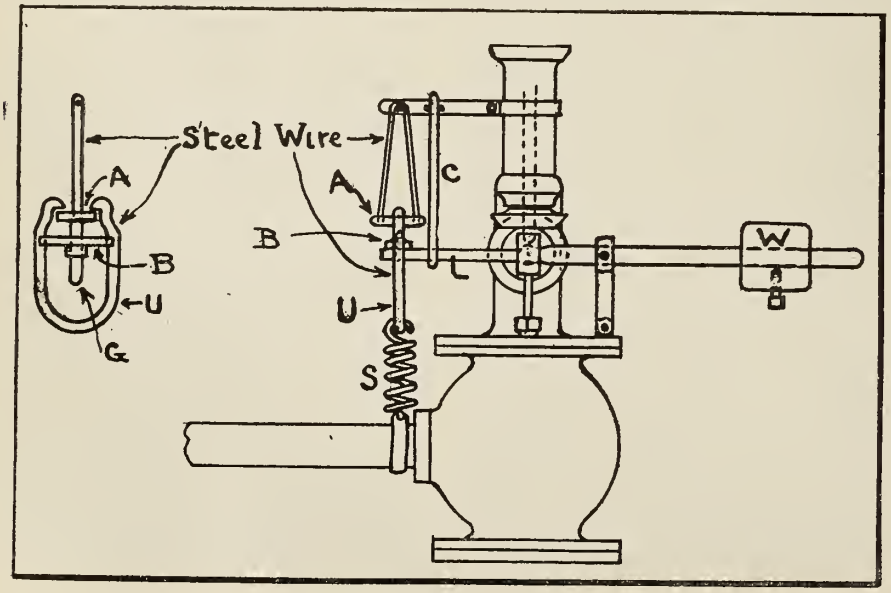
A smaller horizontal pump, having similar seats, was also giving trouble when pumping crude oil. We had discontinued its use and were on the point of ordering a larger one, but elated with our success on the boiler feed we decided this one could be fixed up in the same manner, and after a few hours work had the oil pump back on the job once more.

AN ENGINE STOP.

By David R. McNally.

THE illustration herewith shows a simple form of engine stop which any engineer can make and apply. In case of the governor failing, the balance weight, (W) raises the sliding block (B), causing the U-shaped wire link (U) to spread out at the top and thus become released from the fixed block, (A). The coil spring, (S), then pulls down the link (U), and with it the lever (L), thus closing the governor valve. The block (B) slides on a spindle (G), which is attached to the fixed block (A). By making the link (C) of suitable length, the valve may be held partly open, thus preventing a dead stop. I have tested this engine stop many times by throwing off the governor belt, and the generator pressure never rises more than 2 volts before the device trips, checking the engine to half speed.

The sketch is intended to show the principle only and is not quite in proportion.



AN ENGINE STOP.

WATER IN ASHPIT.

By J. L.

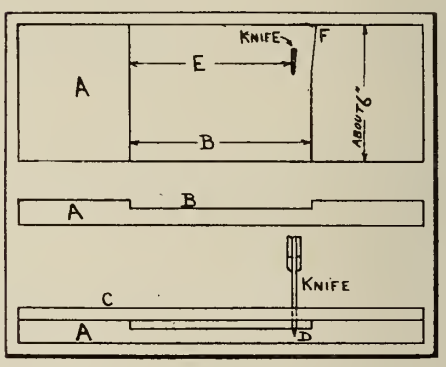
IT is a common thing for engineers to state that keeping water in the ashpit of a steampit of a steam furnace will soon cause the brick work to become soft If they would tell us where they received their information we would be obliged. For the past 30 years the writer's work and experience has been around steam plants, and in a number of cases where dirty, cheap coal was used, and where much clinker formed to worry the engineer and use up his time. His advice always was to put water in the ash pits as a remedy, and whenever used, it proved a sure winner. In a Toronto plant, water was used in the ashpits for 15 years, and much of the original brickwork is still there as good as ever.

Many plants where water is continually used in the ashpits are known to the writer, and in these clinker, seldom gets a grip upon the grate bars. The latter are kept slightly cooler than if the pits were dry, with the result that the life of the bars is lengthened, and it is not necesary to keep the fire doors open for several minutes breaking clinkers off the bars. Further, the air spaces being kept more open, the draft is better than it would be otherwise.

CUTTING DOWN BELTS.

By Retals.

IF you have a belt which is too wide, and you wish to reduce the width by ½ inch or so, take a short piece of board (A), not more than 6 inches wide, and across the grain, cut a groove (B), of the same width as the belt about to be cut. The depth of this groove should be a trifle greater than the thickness of the belt. Next nail across the top a



CUTTING DOWN BELTS.

second board (C), of the same length and width, but only about ½ inch thick. Sink your pocket-knife blade down through the top board and far enough into the lower board to support the blade against the force of the cut, as shown at (D). As a knife blade tapers more or less from front to back, set the blade so that the space at (E) will be parallel. Cut away a clearance at (F) to allow for the taper of knife blade and also to allow the strip of leather that is cut off to escape easily.

With a sharp knife, this makes an excellent job. The belt has to follow the groove; it cannot get away and will be of even width throughout, no matter what the length. This rig is cheap and safe and can be readily made up in 15 minutes. Start the belt through and if no one is neary-by to give a pull, grip one end in a vise and walk away from it.

SCALE PREVENTION.

By John Thorne.

A COMMON source of disagreement among engineers is how to keep a boiler free from scale One man advised me to use "the heel of a cow;" possibly he referred to a hoof. Others more

sensible prefer compound, coal oil, soda, etc. Any of these may help under certain conditions and according to the nature of the impurities in the water. Personally, I prefer a good mechanical cleaner, for my experience goes to show that they will succeed when all other means fail. There are several good appliances on the market and the makers will install them and guarantee results. My last experience was in a plant where from 200 to 300 pounds of scale was removed by hand from each boiler every month. Special compound costing $30 a barrel was used, and with a view to experimenting, a gravity skimmer or boiler cleaner was installed. The results have been particularly gratifying, so much so that at the present practically no scale forms. Every high pressure boiler in the plant now boasts a skimmer.

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STEAM BOILER REGULATIONS.

By G. B.

I WAS greatly interested in the article entitled, "The Steam Boiler," by C. T. R. in your July issue. I agree with C. T. R. that there is plenty of room for improvement as far as legislation is concerned, towards getting ideal boilers; but I do not agree that the Canadian Manufacturers' Association is the best suited body to bring about a code of rules governing the steam boiler.

I understood that it was practically the Canadian Manufacturers' Association who drew up the rules governing the Stationary Engineers' Act for Ontario. Here in Ottawa, to-day, we have men running plants carrying all manner of pressure from 25 pounds to over 100 pounds, and they do not require to hold a certificate. Why? Just because the law calls for a boiler to be of a certain size, equal to fifty horse power. According to the Ontario Stationary Engineers' Act, you don't need a certified engineer for the pressure you carry, but only when the boiler is either 12 ft. long and 48 in. diameter, or over those dimensions, and carrying 20 lbs. pressure or over. I do not think that the present Act is of any use, being too elastic, and C. T. R. must admit that it is the pressure carried in the boiler that causes explosions.

If the Canadian Manufacturers' Association did make up the Ontario Engineers' Act and get it passed through the Legislature, they drew up a very poor set of rules and regulations indeed, and what would be the use of their being included in drawing up rules concerning the "Ideal Boiler" when they have proven themselves so inefficient so far as the Engineers Act is concerned? I would suggest that instead of the Canadian Manufacturers' Association drawing up a code of rules and regulations governing either, boilers or engineers, to be passed through Legislature that they leave it to more competent men—boilermakers and engineers. These are the men who should know how to draw up a code of rules and regulations to govern their profession. Further, all rules and regulations should hold good in every province, so that what was law in New Brunswick or Nova Scotia would be law in Alberta or British Columbia.

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AN UNUSUAL STREET LIGHTING FAILURE.

By J. S. A. B.

THE successful operation of the street lighting of a town possessing an electricity installation is one of the first duties of the management of the electrical undertaking, inasmuch as the failure of any portion of the public equipment constitutes such an adverse advertisement as to the advantages of electric light that it takes a very persuasive solicitor to overcome the arguments. Where electric arc lamps are used, it is, therefore, a matter of routine practice in every well managed undertaking to try the lamps during the daytime after the circuits have been re-carboned in order to see that there is no failure anywhere, and that it may be confidently expected that the arc lamps will light up properly when the night comes on. This occasionally leads to a trouble hunt on the part of the electrical staff, which is amply repaid, however, by the prevention of a regrettable extinction.

On one occasion such trouble occurred through a cause which possesses elements of interest from its comparative rarity and it may be worth while to set down the incident in detail. The town possessed a combined electric lighting and tramways undertaking, and the electric arc lamps were fed on a series circuit principle, utilizing the earth return of the traction system as part of the circuit, although the outgoing cable of the arc lamp system was separate from the traction cable. It was found one day when the lamps were being tried to see if they were all right that a series of arc lamps only just glimmered instead of lighting up brightly. They were tested and the voltage was tried by means of a volt-meter, with the result that it was found that full voltage existed. All the wiring was traced and the earth lead of the tramway rails was also tested. In every instance it was discovered that everything appeared to be in good order.

Trouble Located.

The root of the trouble was, however, ultimately found as follows:—At the time the arc lamps failed, work was being done on the return cable from the car sheds, as the permanent way department were rail bonding on the track at a point some little distance off. When the arc lamps were being tested, the return cable would be disconnected and the current would have to find its best path to the station earth plates. Now, in this system the rails were laid on wood blocks for some distance, while the remaining portion of the track work was laid in cement. The weather at the time was also very dry, and, hence, from the combination of all these causes, the resistance between the point where the arc lamp earth cable was attached to the track and the earth plate at the station was very considerable, with the result that a very large proportion of the voltage was wasted on this resistance. When the rails were bonded-up again and the return cable conected, it was found that the arc lamp circuits lit up quite satisfactorily, and as this was done before night-fall, no harm was done.

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OIL-IMMERSED CIRCUIT BREAKERS.

AN oil-immersed circuit breaker should interrupt an electrical circuit without producting abnormal disturbances in that circuit. In addition to this very important function, the circuit-interrupting device must assist in dissipating the stored electro-magnetic energy of the system connected with it. This can be readily appreciated when we consider that any electrical circuit will have more or less inductance and capacity in addition to its resistance. Hence every electrical circuit will have more or less stored energy, which must be dissipated when that circuit is interrupted.

This dissipation takes place either at the point of interruption or in the circuit interruption; it is manifested principally as heat and chemical energy. Thus, it may be seen that when systems are short-circuited, and the circuit-interrupting devices are opened and closed repeatedly upon this short-circuit, the medium surrounding the contacts of these devices becomes heated. If this medium be oil, it is very likely that the flash-point of the oil may soon be reached, and this will be followed by its ignition. This action will result in an increase of the internal stress in the oil vessels, and may result in an explosion if the device is operated while this condition exists.

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The Vilter Mfg. Co., with offices at 242 Becher St., Milwaukee, Wis., report the following recent sales: The N. K. Fairbank Co., Ltd., Montreal, 42-ton refrigerating plant with 16 x 36 in. Corliss engine; The Frontenac Breweries, Montreal, 250-ton refrigerating plant with two 22 x 42 in. Corliss engines.

PROGRESS IN NEW EQUIPMENT

There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

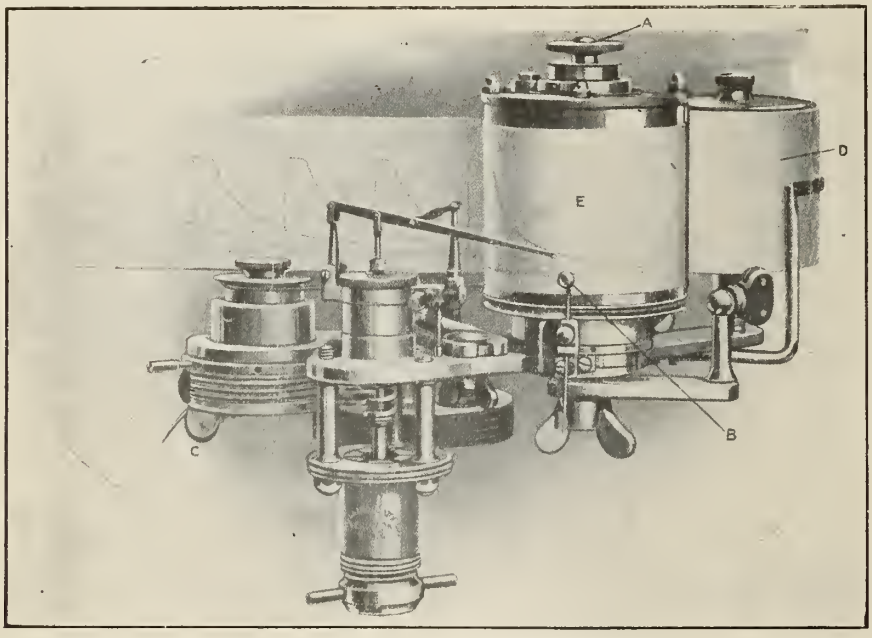
TRILL CONTINUOUS CARD INDICATOR.

THE Trill continuous card indicator produces a card for every stroke of the engine without further attention on the part of the engineer after connection has been made. It is attached in the ordinary way.

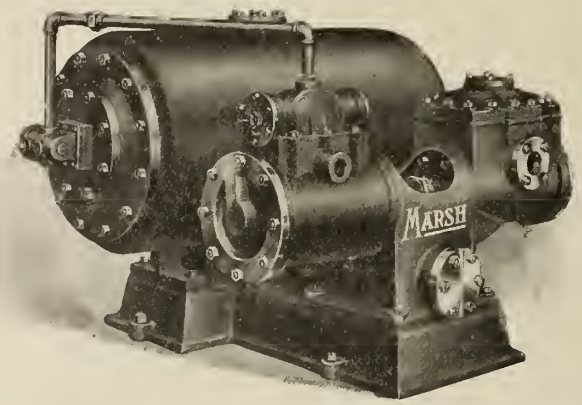
A roll of paper is placed on the smaller drum D and the free end threaded around the larger drum E on which the diagram is traced. To avoid the necessity of tracing a separate atmospheric line for every diagram, the second pencil B is provided, and set at the atmospheric line given by the first pencil, thereafter it traces a continuous atmospheric line the length of the card. The cord is pulled out to its full length and held by the detent C. The cord hook is then attached to some part of the crosshead from which the driving motion is obtained. Releasing the detent C starts the indicator. For a continuous card, the nut A is screwed down, which sets the paper translating device into action, and a series of diagrams will be traced, as shown in the illustration. This strip of paper can be torn off at any place and the diagrams examined. A spring and catch hold the tracing pencil against the drum when taking continuous diagrams assuring a uniform pressure on the pencil point.

If a continuous diagram is not desired, the nut A is loosened while one diagram is being traced, and then tightened while the engine makes two revolutions, which brings an entire new sheet of paper on the tracing cylinder and another complete diagram can be traced by loosening nut A. Separate diagrams can thus be taken whenever desired. The spring of the indicator is entirely outside of the cylinder, being thus removed from the high temperature steam, or the cutting action due to wire drawing. The position of the atmospheric line on the drum can be adjusted by turning the small nut on the pencil motion on top of the cylinder. Each indicator has two cylinders, one having an effective area of a ½ sq. inch for low pressure work, the other an effective area of a ¼ sq. inch for high pressure gas-engine work.

This indicator is manufactured by the Trill Indicator Co., Corry, Pa., and was a feature of the exhibition of Power Plant Equipment at the recent C. A. S. E. Convention in Belleville, Ont.



THE TRILL CONTINUOUS INDICATOR.



IMPROVED AUTOMATIC GOVERNOR VALVE.

IMPROVED AUTOMATIC GOVERNOR VALVE.

THE American Steam Pump Co., of Battle Creek, Mich., have recently placed an improved governor valve on their line of Marsh automatic feed pumps and receivers which is attracting considerable attention among heating engineers and heating contractors generally. As shown by the illustration, the automatic valve is placed at the end of the receiver tank instead of at the top as formerly, and consists of an ingenious arrangement of a semi-rotative balanced valve. This valve has the decided advantage of always wearing to a perfect seat, instead of being constructed in the usual manner wherein the wear tends to produce not only leakage but sticking both on the seat and off, either of which would prevent the automatic operation

of the device. The extreme simplicity of the valve makes it practically impossible to get out of order, and as the governor valve is usually the first part of this type of pump to show wear, the improvement will undoubtedly be appreciated by those who have occasion to use this type of apparatus in returning the condensation from their heating systems directly to the boiler.

The above company make a specialty of pumps for heating systems and their lines of Marsh Vacuum Pumps and Marsh Automatic Feed Pumps and Receivers are a recognized standard for heating specifications.

THE ENGINEER AS EXPERT WITNESS.

IT is sometimes the duty of an engineer to appear as a witness. It is not always an agreeable duty, and it is one which cannot be lightly undertaken, for in the performance of it the engineer stands very much in the limelight. The cases in which he is likely to appear come under two heads—first, those in which he acts as an expert; and secondly, those in which he merely gives evidence of facts within his knowledge. When he is a witness between an employer (to use a compendious word) and a contractor concerning the execution of work for which he was engineer, he will probably speak merely as to matters of fact. On the other hand, unless he has been the engineer on the job, he will probably appear merely as an expert.

It is proposed to consider a few matters which the engineer will do well to bear in mind when he is asked to attend at court.

The Preparation of a Proof.

In the first instance, he will probably be required to furnish a proof to the solicitor. If the litigation which is in progress concerns a contract with which he is familiar, he should have no difficulty in narrowing his statement down to the actual matters in dispute. He probably knows more about the matter than any one else. Sometimes he will draw the proof himself, but more often it is drawn by the solicitor from material elicited from the witness by question and answer. It is difficult to overrate the importance of absolute candor when discussing the case with the solicitor of the party in whose interest the witness is to be called. Nothing should be kept back. Even the most damaging facts should be divulged. If they are not mentioned to the plaintiff's solicitors the plaintiff's counsel may be taken wholly by surprise in court, when there will be but little opportunity for dealing with the difficulty.

The expert must be prepared for certain disappointments. In the first place, he may be summoned to court and made to sacrifice a whole day's work at his office, only to find that the case is adjourned or settled. Then, even if he is called, he may find that, although he gave quite a long proof or written statement to the solicitors, the lawyers content themselves with asking him one or two questions, omitting all reference to what he considered to be of the utmost importance. Finally, the judge, in giving his judgment, may ignore the evidence of the expert or pronounce adversely to it. Fortunately none of these things make any difference to the amount of the witness' remuneration.

Use of Notes, Reports, Etc.

The technical cases with which an engineer is concerned generally involve the use of notes, reports, and plans. As to notes and reports made by him in the course of his professional duties, these are certainly not admissible in evidence so long as he is alive to give evidence of the matters to which they relate. The question of whether they are admissible after his death depends upon a variety of circumstances. A report drawn up by an engineer in the course of his duty which has generally been accepted by his profession would probably be admitted.

To the rule that reports and notes are not admissible in evidence it is necessary to make an exception. If notes, etc., "were made at the time" they may be used to refresh the memory. For instance, suppose an engineer has to depose as to the progress of the work on a particular day. He will, in the ordinary course, have made entries in a rough notebook, by means of which he can subsequently draw up a report. When challenged in Court he may refresh his memory, not with the report, but with the rough notebook. If he is cross-examined about the notebook and the cross-examiner demands to see it, it becomes evidence per se, and is, of course, evidence of the most valuable kind.

Another duty which frequently falls to the lot of the engineer or surveyor is that of preparing plans which are to be used in Court for the purpose of indicating to the jury the locus in quo of an accident. Such a plan should be prepared and marked as a mere naked presentment of existing fact. It should not have any mark upon it which would indicate where the alleged accident took place, as that would be the mere result of hearsay evidence.

The Value of an Opinion.

That the opinions of scientific men are evidence is clear from a number of cases. For instance, in an action for a nuisance, an architect acquainted with the locality might be asked whether the nuisance depreciated the value of the houses in the neighborhood. The expert, however, may not give his opinion as to the merits of the case, but only as to the facts as proved at the trial. In one case the question was whether a bank which had been erected for the purpose of preventing the overflowing of the sea had caused the choking up of a harbor. It was held that the opinions of scientific men as to the effect of such an embankment on the harbor were admissible.

The expert who is being cross-examined as to his opinion is frequently confronted with passages from leading textbooks. He should, therefore, take care to make himself familiar with what has been written on the subject in hand. For instance, suppose the question at issue is the cause of the collapse of a bridge. Professor A.B. may have published a book containing a chapter on the subject, and a passage from this book may be quoted to a witness. For the witness to know that in a later edition the author recanted his views and adopted or propounded a new theory is very convenient and rather embarrassing to the counsel in the case.

It frequently happens in litigation relating to buildings that all the evidence is taken down in shorthand and transcribed from day to day. In that case a witness will probably have an opportunity of perusing his evidence soon after giving it. Should he be incorrectly reported he will do signal service to the party for whom he appears by pointing out the error. Otherwise it may be overlooked and cause endless trouble in subsequent proceedings.—T.E.S.

HIGH PRESSURE GAS FOR MANUFACTURING.

IN a paper on "High-pressure Gas for Manufacturing Purposes," Mr. A. W. Onslow states that experience has shown that, with gas at 50 cents per 1,000 cubic feet and coal at $4.90 a ton at the furnace, there is very little difference in the cost of the two methods of heating; the difference being in favor of gas, when used for practically all commercial purposes, provided the gas furnaces are designed with a view to the greatest economy. There are instances where gas is infinitely cheaper, cleaner and more suitable in every way. The exception is with large furnaces when immediate contact of flame with refractory material is difficult.

Saskatoon, Sask.—The management of the Metal Shingle and Siding Co., of Preston, Ont., will erect a branch factory in this city. It is reported that the cost will be $100.000.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

Port Aiberni.—J. A. Kendall & Sons, fish dealers, are having their fish rooms equipped with a 5-ton refrigerating plant furnished hy the Armstrong Machinery Co., Spokane, Wash. Installation is by the Modern Refrigerating Co., Vancouver.

Vancouver.—David Spencer, Ltd., department store, is having installed by the Modern Refrigerating Co., of Vancouver, a 25-ton Vulcan refrigerating plant.

Vancouver.—The Swift Canadian Meat Co. are having their new meat coolers equipped with 25,000 lineal feet of 2-inch direct expansion piping by the Modern Refrigerating Co., of Vancouver. A 35-ton York refrigerating machine was installed recently.

Vancouver.—Parsons & Haddock, butter and egg dealers, have installed a 12-ton "Triumph" refrigerating machine. The cold storage rooms are being equipped with 3,000 feet of 2-inch direct expansion hy the Modern Refrigerating Co.

Victoria.—St. Joseph's Hospital is heing equipped with a 2-ton refrigerating machine supplied by the Armstrong Machinery Co., Spokane, Wash. The Modern Refrigerating Co., of Vancouver are installing it.

Victoria.—D. K. Chungranes, Ltd., is huilding an addition to his fish storage rooms. Contract for insulation and piping was let to the Modern Refrigerating Co., Vancouver.

Salmon Arm.—Mr. Wm. E. Maclean, representing Dutcher, Maxwell & Co., the engineers who will install the city waterworks and electric light systems, the former to cost $45,000 and the latter $22,000, by-laws for which received the assent of the electors, has been making the necessary surveys preparatory to having the details of the system specifically gone into. There is every likelihood of the systems heing installed before the coldest weather sets in.

ALBERTA.

Calgary.—The Canadian Pacific Railway Co. is having installed at its demonstrating farm, a 2-ton belt-driven York refrigerating machine; installatiou heing by the Kent Co., Montreal.

Gossip of the Trade

The Jeffrey Mfg. Co. with headquarters at Montreal, report the completion of another boiler house equipment for J. R. Booth, Ottawa. They have also recently closed contracts for similar equipments with the Ottawa Electric and Ottawa Electric Railway companies.

Siemens Bros., Canadian Birkhead Building, Toronto, have on order for the Canadian Collieries, Union Bay, B.C., two electric hoisting engines, together with electrical control apparatus. The first has a peak load of 1,300 h.p., and the second a peak load of 700. The same company are also supplying two motor generator sets, one for each of the above hoisting engines.

Mr. G. C. Royce, Canadian representative for Ferranti, Limited, will shortly remove from 1688 Dundas St., West Toronto, to larger and more central offices at 90 Sherbourne St. A showroom will be maintained in which will be exhibited the many lines of Ferranti electrical goods, meters, switch boards, transformers, switches, current breakers, etc.

Mr. C. W. Ward, of Messrs. Reavell & Co., Ltd., of Ipswich, Eng., is home again after having been in Canada in connection with air compressors supplied to the Water Commissioners of London, Ont. The Messrs. Reavell & Co., Ltd., being of the opinion that a mistake had been made in testing the plant, sent Mr. Ward out to locate the trouble. The results of further tests demonstrated the efficiency of the plant, and it has been accepted without any alteration being made.

The C. A. Dunham Co., Ltd., makers of the well known Dunham Steam Traps, have commenced operations in their new factory on Davenport Rd., corner Primrose St., Toronto. The new building, while complete in every detail, within itself, allows for extension as the business grows. The factory embraces many desirable features, among them an abundance of daylight, ample provision for heating and ventilating; a gallery shop with freight elevator service (Otis Fensom), and other modern ideas. A department which should be of interest to engineers is one in which a testing apparatus is being installed. This department will be thrown open to engineers who may wish to test a Dunham or any other trap. Engineers will be permitted to make their tests in private and their finding will be known only to themselves. The Dunham Co. are manufacturing steam traps and vacuum heating and ventilating systems. Mr. A. J. Deakie, general manager of the Canadian business comes from the parent office at Marshalltown, Iowa. Branches will be maintained at Montreal, Winnipeg, Calgary and Vancouver.

COST OF OPERATING A 4-TON MOTOR TRUCK.

THE Howards Co., New Haven, Conn., has been operating a 4-ton motor truck, built by the Kissel Motor Car Co., Hartford, Wis., and the data compiled on this cost indicate that in 12 months the truck will effect a saving of $1,600, as compared with the cost of maintaining three two-horse teams, formerly required to do the company's hauling. This saving is effected after considering as depreciation the entire cost of the truck. A comparison of the cost of maintaining three double teams and operating the 4-ton truck is as follows:

THREE DOUBLE TRUCKING TEAMS.

Cost of six horses at $300	$1,800.00
Cost of three wagons at $450	1,350.00
Cost of six harnesses at $35	210.00
Cost of keeping horses, $25 a month	1,800.00
Repairing harnesses, wagons, etc.	100.00
Interest on investment	336.00
Drivers' salaries, $12 a week	1,872.00
Total	$7,468.00

"KISSEL-KAR" FOUR-TON TRUCK.

Cost of 4-ton truck	$3,800.00
Gasoline, 2,400 gals. a year at 10c.	240.00
Oil, 156 gals. a year at 23c.	35.88
Drivers' salary at $18 a week	936.00
Amortization, 10 per cent. on $3,800.	380.00
Interest on investment	380.00
General overhaul, once a year	150.00
Total, truck	$5,921.88

This shows a balance in favor of the motor-driven vehicle of $1,546.12.

During the first few months of its operation the truck averaged 484 miles and the gasoline and oil consumption daily were 7.6 gallons and 2 quarts, respectively. It will be noted that in the figures covering the cost of operating the truck that in addition to charging the first cost of the truck, 10 per cent. is charged for depreciation. On this basis the economies effected by the use of the 4-ton truck are much greater than the figures indicate. These figures demonstrate that a truck can replace 8 to 10 horses and still effect an annual saving of approximately $2,000. If the truck owner had written off 20 per cent. for truck depreciation and estimated the truck's life at five years, a net saving of $3,000 per year would have been effected.

READER'S QUERIES.

(1)—Will you please describe a short and effective method of lining-up a single cylinder slide valve engine.

(2)—Please outline the procedure to be adopted in lining-up, when the crank shaft and flywheel are in position.—T.H.

Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

HON. J. S. DUFF,
Minister of Agriculture

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto

BIG

RESULTS
from small investments. This little advertisement will give you an idea of the use you can make of smal space.

Why Consider the First Cost

When by paying higher prices your brush cost is reduced and commutator wear abolished.

The

"LE CARBONE" BRUSH

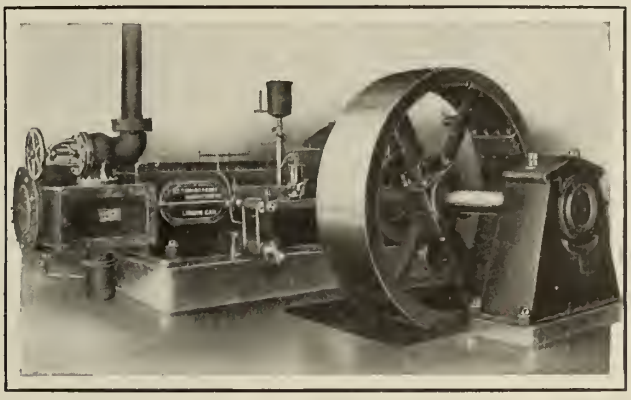
will do this and more for you. Although the highest priced brush on the market, it is known the country over as the most economical.

We have a most instructive catalogue, showing Carbons for Commutators, Slip Rings, and Telephones.

SEND FOR IT.

ROUGIER FRERES, INC.

63 Notre Dame East, - - MONTREAL



Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY

E. LEONARD & SONS, LONDON, ONTARIO

MANUFACTURERS OF

High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants.

WAREHOUSES AND AGENCIES AT

MONTREAL, ST. JOHN, N. B., CALGARY, WINNIPEG, VANCOUVER

The advertiser would like to know where you saw his advertisement—tell him.

SASKATCHEWAN.

Regina.—The government hospital for the insane in this province is to he equipped with a 4-ton York refrigerating machine and brine system, to be installed by the Kent Co., Montreal.

Moose Jaw.—The Swift-Canadian Co., Ltd., it is reported, will establish a branch meat station and cold storage warehouse in this city in the near future.

Regina.—The City Cold Storage Co., have completed and opened for business a new cold storage warehouse. It is a 3-storey brick structure, containing in all 16 cold storage rooms, eight of which are piped for sharp freezers. The other rooms are cooled on the air circulation principle. A 20-ton York refrigerating machine furnishes refrigeration. The enterprise was assisted by a subsidy of 30 per cent. of the cost hy the Dominion government.

Yorkton.—The town engineer, Mr. Talbot-Crosbie, has under preparation a set of plans showing a method of securing a suitable supply of water for this municipality. Test wells are being sunk and should these be inefficient the supply will be secured from York Lake. If the lake is resorted to, it is proposed to take the water from a ravine by gravitation or pumping, through a filtration system into a storage reservoir with a capacity of at least 100,000 gallons.,

Biggar.—Mr. R. Moses, representing the Brydges Engineering Co., of Winnipeg, was here recently with regard to the installation hy the town of a municipal electric-lighting plant. This gentleman considered that Biggar is in such an advanced stage that she certainly needs a large plant for light and energy, and he saw some of the councillors on the subject. After mature consideration, however, these gentlemen thought that the time was hardly ripe for this to be taken in hand at once, but that such a scheme should soon be brought before the people.

MANITOBA.

Winnipeg.—The Manitoba Cold Storage Co. has let contracts for erection of a 4-storey cold storage warehouse with foundation sufficient for four additional storeys. The structure will be 100x150 feet and cost about $75,000, exclusive of equipment.

Winnipeg.—It is reported that the Consumers Ice Co., F. E. Cryder, managing director, will establish an ice making plant on the vacuum system at Norwood, Man., at a cost of approximately $350,000.

Winnipeg.—The Stanley Mineral Springs & Brewing Co. have awarded contract for installation of a 75-ton vertical, cross-compound refrigerating machine, including direct expansion piping and brine cooling system, to the Frick Co., Waynesboro, Pa.

Winnipeg.—T. Eaton & Co., will improve the refrigerating plant in their department store by adding a 11-ton York refrigerating machine to be installed by the Kent Co., Montreal.

Winnipeg.—The Crescent Creamery Co. is building a 100-ton raw water ice-making plant and also an ice cream factory to have capacity of 6,000 gallons per day and to be equipped with an 18-ton refrigerating and dry hardening plant. Contract for the two machines was let to the Larsen Ice Machine Co., Chicago.

ONTARIO.

Toronto.—The Belle Ewart Ice Co., Toronto, have installed at their plant at Lefroy, a Gifford-Wood Co. gig lowering machine for handling ice cakes 12x32 inches in dimensions. The machinery was shipped from Hudson, N.Y.

Hamilton.—The Hamilton Dairy Co. has had its dairy equipped with a 13-ton refrigerating plant, supplied by the Creamery Package Mfg. Co., De Kalb, Ill.

Hamilton.—John H. Pickett, dealer in fruits and produce, 35 Holton avenue, N., contemplates building a cold storage warehouse and is investigating plans, machinery, etc.

Toronto.—Wm. Neilson, Ltd., confectioner and ice cream maker, is adding to his refrigerating plant a 10-ton ammonia compressor manufactured hy the Creamery Package Mfg. Co., De Kalb, Ill.

Toronto.—The Toronto Terminal Cold Storage Co. has been organized and will establish a cold storage warehouse of at least 1,000,000 cubic feet storage space. The company has a capital stock of $300,000 and a bond issue of $500,000.

Fort William.—The Canada Iron Corporation of Fort William, have the contract for the supply and delivery of a quantity of cast iron and lapwelded steel pipe.

York Township.—The sub-committee of the Council of the township of York met the engineers of the Hydro-Electric Company in the Township Solicitor's office recently to discuss rates for street lighting. The previous offers to the Council covered the installation of poles and wires, and the supply to private individuals, but did not make any offer with regard to street lighting in the township. The Hydro-Electric Commission were asked to make an offer to cover this.

Steelton.—The town engineer recently presented his estimate of the value of the Tagona Water & Light Co.'s plant in Steelton, placing it at $3,600, while the company's valuation is $4,000. The engineer's estimate was accepted and this amount less ten per cent. for the water mains and connections owned by them in the town will be offered the company.

Dunnville.—The Board of Water Commissioners has purchased two gas engines from the city of Berlin. These machines were not needed after the advent of the Hydro-Electric energy to that municipality. They will be used in the pump house of Dunnville.

Orillia.—The town's waterworks system made a profit during the year of $3,092.61, as compared with $2,891.23 in 1911. The receipts were:

Water rates	$ 9,000.00
Hydrant services	2,010.00
Refunds	400.00
Total	$11,410.00
The expenditure:	
Debenture and Interest	$ 2,685.26
100 h.p. motor	1,600.00
Shortage, 1911	332.13
Expense account	3,700.00
Total	$ 8,317.39
Profit	3,092.61
Total	$11,410.00

Milton.—The Town of Milton is the latest convert to public ownership, and now that the townmen have decided upon the installation of electrical power, they want the hydro-electric in a hurry. A delegation of manufacturers, headed by the mayor, called upon the Hon. Adam Beck, chairman of the Ontario Hydro-Electric Commission, recently, and asked for the immediate equipment and erection of a line to carry four or five hundred horse power to their town. An agreement has been drawn up hy the parties representing the town and the Hydro-Electric Commission, which will facilitate immediate action as requested. Work will be commenced at once on the extension of the Brampton line, and the town council will give the necessary by-law two readings before submitting it to the people. The installation will cost approximately $26,000.

Russell.—The Hydro-Electric Commission is in receipt of a request for estimates on 1,500, 1,000 and 750 horse power to be supplied to the Town of Russell. The installation of hydro power in this township will necessitate the extension of the Morrisburg, Prescott and Brockville line.

Smith's Falls.—A deputation from Smith's Falls waited upon Hon. Adam Beck recently regarding particulars and estimates on hydro power.

Galt.—Negotiations are under way between the Hydro-Electric Department of the town of Galt and the Grand Valley Railway Company for the latter to take 200 horsepower to run its cars from here to Paris. It is understood that what the company wants is direct current of 550 volts, while that at the local substation can only be delivered at 220 volts, alternating current. The proposal is that the machinery to make the necessary change he installed in a building owned by the town on the river road. This has not yet been decided upon, and in the meantime definite action is deferred.

Berlin.—The Light Commission has received a request for hydro-electric power from the Canadian Consolidated Rubber Company. According to estimates of the company's engineer, 2,280 horse-power will be required for the automobile tire factory now in course of construction, and a similar amount for the company's other three factories. An idea of the magnitude of this request may be gained from the fact that Berlin's contract to-day is for only 1,000 horsepower. The new industry will thus use twice as much power as does the entire city. A conference will be arranged with the Hydro-Electric Commission to fix the price for this amount of power.

QUEBEC.

Montreal.—Messrs. Munderloh & Co., Ltd., have obtained a large contract for supplying steel pipe in sizes varying from 8 in. to 20 in., for Medicine Hat. Mr. R. S. Lea is consulting engineer.

"O'Malley"
"Multiplate"
(Patented)

HEAD AND SEAT PLATES FOR GLOBE-VALVES

Thin Metal Plates take the place of rubber discs and other like Compositions.

Can be applied to any Standard Valve.

For Sale by

TALLMAN BRASS AND METAL COMPANY
Manufacturing Agents
HAMILTON, - - ONTARIO

"Angle or Globe"

"AUTOMATIC"
Cushion Non-Return and Triple-Acting Valves
"Work Both Ways"
Largest Steel Co. in the world ordered over 1000 of our valves for the protection of their
"Power Stations"

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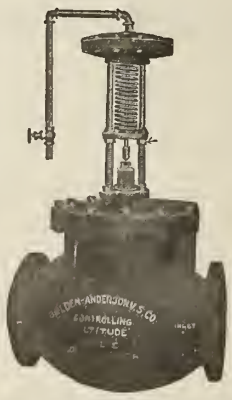
Illinois Steel Co



"AUTOMATIC"
"The Controlling Altitude Valve"

main ain a uniform stage of water in stand-pipes, reservoir or tanks.

No overflow in case of fire pressure. Valves automatically closed by water or electricity.

"Quick Closing Valves"
"Sandpipe Valves"

Automatic Valves
For Steam and Water Service

Anderson Reducing Valves for Steam or Water.

GOLDEN-ANDERSON VALVE SPECIALTY COMPANY
1233 Fulton Building
PITTSBURGH, PA.

What a Liberty Cleaner has done

Nine years' accumulation of scale removed by a LIBERTY in 22 minutes. The boiler contained 144-4" tubes 18' long. The longest time required for cleaning one tube was 22 minutes.

The owners did not think they had enough scale to cause trouble, but consented to a trial. The result was a complete surprise to them. Have **you** any scale in your boilers? It may pay you to investigate.

Liberty Cleaners are always reliable, durable, economical and efficient. Made for every type of boiler and to meet all conditions and to be operated by air, steam or water as required. No scale so hard that a **Liberty** cannot remove it in record time. Write for catalog.

Liberty Manufacturing Company

6904 Susquehanna Street **PITTSBURGH, PA.**

Canadian Representatives:

Williams & Wilson Ltd., Montreal. A. R. Williams Machinery Co., Toronto and Winnipeg.

Shut Downs are Expensive

The TWIN STRAINER protects your power plant against shut downs by keeping such trash as fish, leaves, sticks, grass, etc., away from your pumps, condensers and boilers.

The TWIN combination—**Two baskets, two valves**—can't be equalled for simplicity, durability and accessibility. One side of strainer always in service, while the other is free to be cleaned.

Do you want to be shown what our strainer will do? The above cut shows a six hour catch of fish, water dogs and leaves made by a TWIN.

Send for a catalogue and learn more about them. Write us or our nearest branch.

ELLIOTT COMPANY

6902 Susquehanna Street, **Pittsburgh, Pa.**

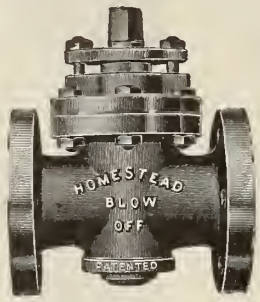
CANADIAN REPRESENTATIVES:

Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

The advertiser would like to know where you saw his advertisement—tell him.

HOMESTEAD
STRAIGHTWAY VALVES

ALWAYS OUTLAST
OTHER VALVES



For Pressure Up to
5000 lbs. per. Sq. In.

The reason is very evident.

Where the common Globe and Gate Valves have their vital parts—the seats—exposed to pressure and constant wear, every minute they are open, the seat of the Homestead Straightway is never exposed.

The plug is balanced and held in place by the pressure when open, and when closed it is locked in the seat by our patent wedging cam, insuring freedom from friction in the seat while the plug is turning and making the Homestead the quickest acting, the simplest, the most easily operated and the most durable valve known.

Let us send full details. Write

Homestead Valve Mfg. Co.
PITTSBURG, PA.

Just Out
GRAPHITOL
Pat. and Trade Mark Reg'd.

The new graphite bearing material, made in the form of a fine, dry powder, and a prepared liquid, which are mixed together as required, into a stiff paste, moulded into place and allowed to set, becoming very hard and durable.

Write for illustrated pamphlet containing full particulars, to

British Pacific Supply Company
F. C. Winkler, Manager,
VICTORIA, B. C.
MAKERS OF GRAPHITOL.

These are the telling points about
Bakelite
Valve Discs

They will not leak under high temperature, excessive pressure or when used in acids or other special liquids. Neither cold water, dry or superheated steam has the least effect upon them. **BAKELITE** Discs are a gas-tight fit.

BAKELITE is a successful substitute for expensive metal. Its structure is fibrous, giving strength and hardness. It can be reground and refaced, always retaining a uniform surface. It cannot be injured, except by accident or friction. Remember Bakelite **PUMP VALVES** do not warm with changes of temperature.

Order your valves fitted with Bakelite Valve Discs and stop that perpetual annoyance and expense caused by leaking valves. Depend upon it, Bakelite Valve Discs will not leak.

WRITE FOR PRICES OR ASK YOUR DEALER.

PLASTICS, Limited, - Van Horne St., TORONTO

Sole Agents for Alberta, Saskatchewan and Manitoba.
Bakelite Valve Discs and Pump Valves.
GENERAL SUPPLY CO. of CANADA, LIMITED, Winnipeg.
Head Office, Ottawa. Branches: Winnipeg and Toronto.

MADE IN CANADA

The Lowest in Cost and Best
High Pressure Gaskets
On the Market

Because 1. They are permanent. 2. They are easy to apply. 3. They are easy to remove. 4. It is impossible to blow them out. 5. They will not stick to the metal. 6. They can be used over again. 7. They are not affected by high temperature. 8. Cleaning the joints after using these gaskets is unnecessary. 9. There is no danger of of damaging the gaskets in breaking or making the joint over. 10. There is no time lost in preparing these gaskets for the joint. They are always ready.

Write us at once for circulars and prices, and avoid duty.

CANADIAN GASKET COMPANY
BRIDGEBURG, ONT.

Montreal.—The following contracts have been awarded: Three city trucks one at $3,500, two at $3,200, supplied by Messrs. W. E. Seagrave & Co., of Walkerville, Ont.; fire engine, $5.-800, by the Waterous Engine Co., 72 Queen St. W., Torouto.

Montreal.—Mr. C. H. Cahan, President of the Western Canada Power Co., recently announced the sale of 40,000 horsepower to interests associated with the British Columbia Electric Company.

NEW BRUNSWICK.

Moncton.—At a meeting of the Water and Light Committee it was decided to award the contract for laying the city water pipes to Messrs. Doclty T. LeBlanc and Fred. Bourgeois.

BEAUHARNOIS ELECTRIC COMPANY.

A new electric company has obtained letters patent from the provincial government of Quebec. It is called the Beauharnois Electric Co., Ltd. The new company will have powers in the city of Montreal, and in the counties of Laval, Jacques Cartier, Hochelaga, Laprairie. Chateauguay, Beauharnois, Two Mountains, Argenteuil, Soulanges, Vandreuil, Terrebonne, L'Assomption, Chambly, Huntingdon, Napierville, St. Jean and Iberville. They intend to construct large power houses and electric plants at different places. The Beauharnois Electric Co., Ltd., is on independent company and declares they will never consent to join any trust or combine. The first generating station will likely be constructed at Beauharnois and the power will be taken from the rapids in that locality.

$350,000 ICE PLANT FOR WINNIPEG.

A most important addition to Western manufacturing concerns will be the Consumers Ice Company, which has just decided to erect in Norwood, Winnipeg, a plant costing $350,000. They have already secured a site of two acres. The product of the works will be clear, pure, hygienic ice, from natural artesian water under the Harrison process which is in use in Chicago, Detroit, Columbus, Indianapolis, Minneapolis, and many other large cities in the United States. The Norwood plant will be the first in Canada. The Consumers Ice Company is made up of leading Winnipeg men, with the exception of Alexander Harrison, of Chicago, who is one of the leading shareholders. The company intends to commence operations at the earliest possible date, so the building will be rushed to completion, and the machinery installed without delay. The plant will consist of compressors and generators of the very latest type. The capacity of the plant at the beginning will be 300 tons a day, and about 40 people will be employed. The company will sink two eight-inch wells, from which it is expected an ample supply of water will be secured. The contract will be let immediately for the buildings, which will include the following:—Main building, 90x231; two other buildings, 50x97 feet each; garage, 60x85 feet. The company's delivery will he made entirely by auto-truck, and about 30 machines will be used.

WINNIPEG'S POWER PLANT PAYS.

Winnipeg's municipally owned hydro-electric light and power plant, completed last year, is now firmly established on a paying basis and also in the estimation of the people of the city. The fact that it has heen the means of reducing the cost of domestic lighting 66 per cent. of the rate previously charged by a private corporatiou has gained for it the general patronage of the people, and it is now learned that even at this low rate, the plant is uow paying the cost of operation and maintenance. Applications for the installation of civic light and power are now coming in fast, and the department report a substantial increase in contracts for power, which is supplied at cost to manufacturers. The new civic plant has undoubtedly proved a strong factor in inducing industries to locate in Winnipeg, and inquiries regarding rates are received in almost every mail by the Industrial Commissioner, Chas. F. Roland.

CATALOGUES.

The Duncan Electric Co. have published a very neat catalogue of electrical specialties. It contains a complete list of their lines with illustrations and prices of all the apparatus they manufacture, consisting of sockets, switches, cutouts, rosettes, etc.

The Antipack Valve Co., Ltd., 67 Bleury St., Montreal, have sent us a pamphlet on the new Antipack Valve which is claimed to be nonleakable and requires no packing. A copy of the circular will he sent on request.

CLASSIFIED ADVERTISING

FOR SALE

BELTING FOR SALE—800,000 FEET OF best quality leather, rubber, hair and canvas belting, bought from bankrupt manufacturers at 25% to 75% less than the regular valne. Also a large quantity of slightly used belting, piping, chains, rails, pulleys, hangers, cotton waste, etc., at very low prices. Send for catalogue. Imperial Belting and Supply Co., 5 Queen Street, Montreal.

SALESMEN WANTED

LAKE ERIE BOILER COMPOUND CO. REquire a few first-class representatives to sell their well-known compound. Liberal commission paid to live men, and exclusive territory. Write at once, giving references, 11 Colborne St., Toronto. (tf)

WANTED

MOST FAVORABLE TERMS WILL BE given to any firm wishful to take up sole agency for our Patent Flexible Metallic Face Steam Packings. S. Redfern & Co., Swan Lane, Manchester, England. (11)

WANTED—EXPERIENCED ENGINEER TO take charge of refrigerating plant, capacity 250 tons. Must be thoroughly acquainted with engines, boilers and motors. Permanent position. Highest wages paid. Apply Box 117, Power House, Toronto.

WANTED—EVERY POWER HOUSE IN Canada to remember that C. E. Shedrick, Craig Street West, Montreal, is still repairing measuring instruments, both switchboard and portable. Twenty-five years' experience in repairing all kinds and makes on the market. Intregating meters repaired, tested and sealed, and returned on quick time.

Ideas at 2 Cents Each

¶ An idea that's worth anything at all to a Power Plant man is worth more than two ceuts.

¶ It might be worth hundreds of dollars.

¶ Every issue of "THE POWER HOUSE" is full of practical, helpful ideas. You ought to be ahle to sift out four each month that would prove of some use to you. Put a value of two cents on each and your subscription has been paid.

¶ You cannot afford to miss even one issue—you might miss the idea that would be worth hundreds of dollars.

¶ The date on the label of your "POWER HOUSE" wrapper shows when your subscription expires. One dollar will renew it for a year.

Don't put off Renewing—Do it to-day
Neglect blew up the Boiler

U.S. BARKEEPERS FRIEND
METAL POLISH
USED AND ENDORSED BY THE LEADING DEALERS
SOLD ALL OVER THE WORLD

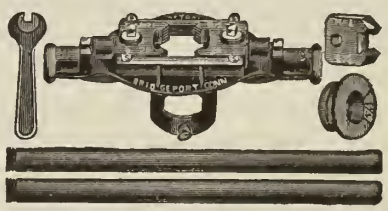
You Might Pay More
For a Pipe Machine than you would pay for The Forbes

But more quality, more operating convenience or higher efficiency isn't on the market.

That may sound a little boastful, but if you will acquaint yourself fully with the Forbes' ideal construction, and the advantages to be derived from the enclosed motor drive, the one-lever control, its portability, etc., you'll agree with us.

Write For Our New Catalogue.

The Curtis & Curtis Co.
26 Garden Street, Bridgeport, Conn.



GENUINE
ARMSTRONG STOCKS
AND DIES
FOR CUTTING PIPE & BOLTS
ARE THE BEST.

PIPE MACHINES
PIPE CUTTERS
HINGED PIPE VISES
RATCHET ATTACHMENTS

Manufactured by
THE ARMSTRONG MFG. CO.
298 Knowlton St.
BRIDGEPORT, CONN.
NEW YORK CHICAGO
Catalog mailed on request

ALLIGATOR BELT LACING

FLEXIBLE STEEL

Makes Joints Quickly.

Only a Hammer Required.

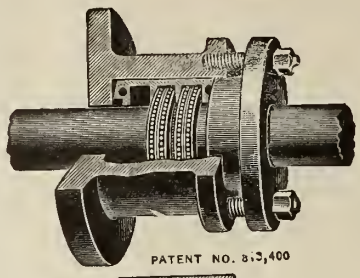
No Holes to Punch.

Forms the Strongest Part of The BELT.

Let Us Send One On Trial.

The Crescent Oil Company, Hamilton and Toronto, Ont

Stocks carried by—Sadler & Haworth, Montreal; Austen Bros., Halifax; P. A. Gouin, Three Rivers, P.Q.; J. S. Mitchell & Co., Sherbrooke, P.Q.; Great West Engine Packing Co., Winnipeg; F. H. Andrews & Son, Quebec, P.Q.; E. N. Jones, St. John, N.B.



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Why not Buy the Best, when in market for Packing?

HOLMES'

Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

Mueller Pressure Reducing and Regulating Valves

Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

DOHERTY MFG. CO., Limited

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Manufacturer for The H. MUELLER MFG. CO., Decatur, Ill., and New York City.

EVERYTHING FOR

Engineers and Draughtsmen

THE ART METROPOLE 241 YONGE STREET TORONTO ARTISTS AND DRAUGHTSMENS MATERIALS

Fabers No. 368, Slide Rule, specially graduated for Electrical Computations.

WRITE FOR CATALOGUE.

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241 YONGE STREET, TORONTO

The Nokoros Patent Union

The only union made absolutely Non-Corrosive. Brass to iron in all contact points. Ball joint; Octagon ends, any wrench can be used. Adapted for heavy service. Every union air tested at factory. Send for circular B, describing the above and other fittings made by

G Tested & uarantee D

OTTERVILLE MFG. CO., LIMITED

OTTERVILLE, ONTARIO

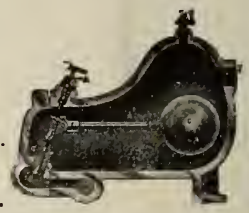
McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



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26 Craig St. MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.

820 Euclid Ave., TORONTO, ONT.

WIPERS

We are the largest firm in Canada making a specialty of the production of **Sanitary Cotton Wiping Cloths** by a new up-to-date process.

We are supplying the largest manufacturing plants, power houses and machine shops throughout the Dominion.

WASTE

We also are manufacturers and large importers of cotton and wool waste. We can quote the very best prices.

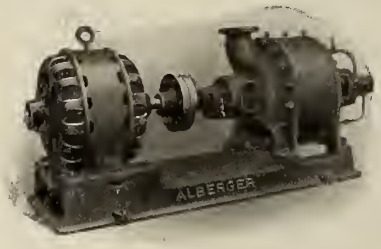
Prices and samples of both waste and wipers sent free on request.

H. GRAY & CO.

23-25 Common St. MONTREAL.

Alberger Centrifugal Pumps

More Water



Less Power

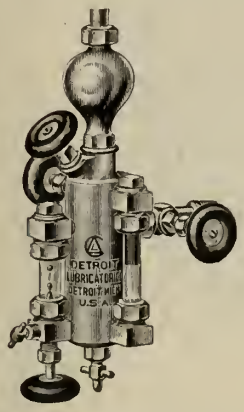
Alberger Pump and Condenser Co.

140 Cedar Street, New York

The advertiser would like to know where you saw his advertisement—tell him.

Detroit Lubricators
for every purpose

The Detroit line includes lubricators for service with every type of steam or gas engine, air compressor or machinery of any kind. One of these lubricators will enable you to eliminate every element of chance or uncertainty from the lubrication of your machine.



Every Detroit Lubricator is the product of scientific study of the conditions under which it operates and embodies every requisite for efficient, dependable, economical lubrication.

NEW CATALOG

The big new Detroit catalog tells about all the different kinds of Detroit Lubricators and gives valuable information on the lubrication of all kinds of machinery.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
Windsor, Ont.

The Problem of Spillage Is Entirely Eliminated

with the use of

The Jeffrey Close-Lip Pivoted Bucket Elevator - Conveyer

for handling Coal, Ashes, Cement, Sand, Stone, Ore and other materials.

With this equipment **Automatic Loaders** are used as shown in illustration above, uniformly filling each bucket.

Buckets are discharged to bins by means of either stationary or movable trippers, both of which may be used on the same conveyer.

Catalogue 32-A, illustrating and describing various installations, sent on request. Write us.

JEFFREY MFG. COMPANY
Canadian Main Office and Works, MONTREAL.
Winnipeg Representatives, N. J. DINNEN & CO.

When All Others Fail

GERMAN VALVE CYLINDER OIL,
GERMAN ENGINE OIL.
STERLING FAST ENGINE AND DYNAMO OIL,
STERLING FRICTIONLESS COMPOUND

will cure your troubles.

Canadian Oil Companies Limited,
Toronto, Winnipeg, Montreal, St. John, Halifax, Calgary.

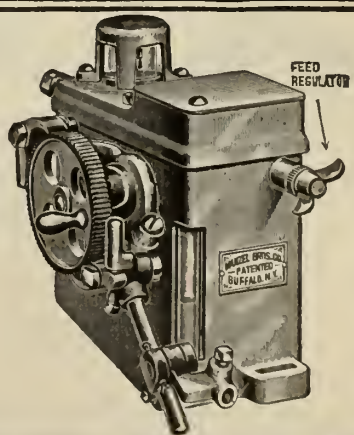
Let Us Send You a Manzel Oil Saving Oil Pump on Thirty Days' Trial

30% OIL SAVING GUARANTEED

You may be able to save as high as 60%. Many others have done so. The "Manzel" New Model Oil Saving Oil Pump is a positive lubricator. It oils the cylinders right all the time, and makes a big reduction in oil bills, besides saving labor and wear and tear on the engine.

You can try a "Manzel" Pump with the distinct understanding that it may be returned at our expense if it doesn't reduce your oil bills at least 30%.

Send for one on these conditions. Catalogue on request.



MANZEL PUMPS are carried in stock by

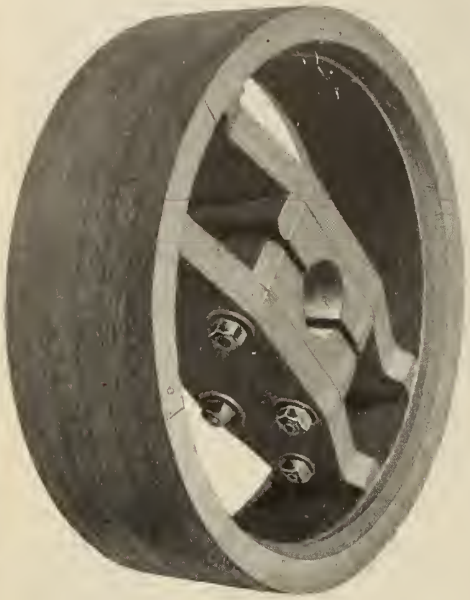
THE TWIN CITY OIL CO.
General Agents Ontario and Quebec
Berlin, Ontario.

BAYFIELD & ARCHIBALD
General Agents for the Northwest.
Molsons Bank Bldg., Vancouver, B.C.

Write to either of the above firms for catalog and full information. MANZEL BROTHERS CO., Buffalo, N.Y.

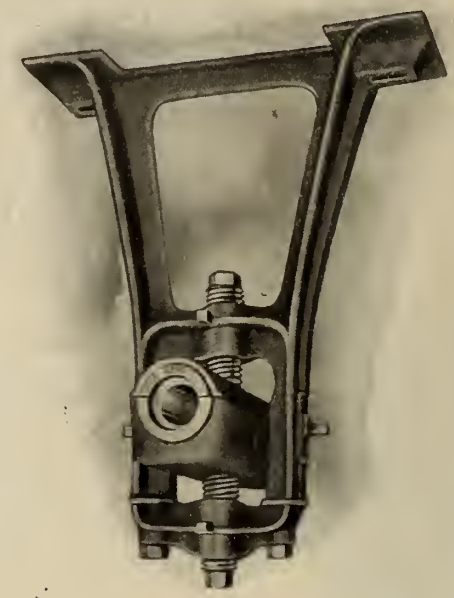
The advertiser would like to know where you saw his advertisement—tell him.

A Combination Hard to Beat



Elmira Ball and Socket Hangers

Elmira Wood Split Pulleys



The Elmira B. & S. Hangers are designed to meet the hardest and most exacting conditions. They are of good weight, correct design, and well proportioned. A Duplex system of oiling is employed consisting of tempered steel rings and woven cotton wick.

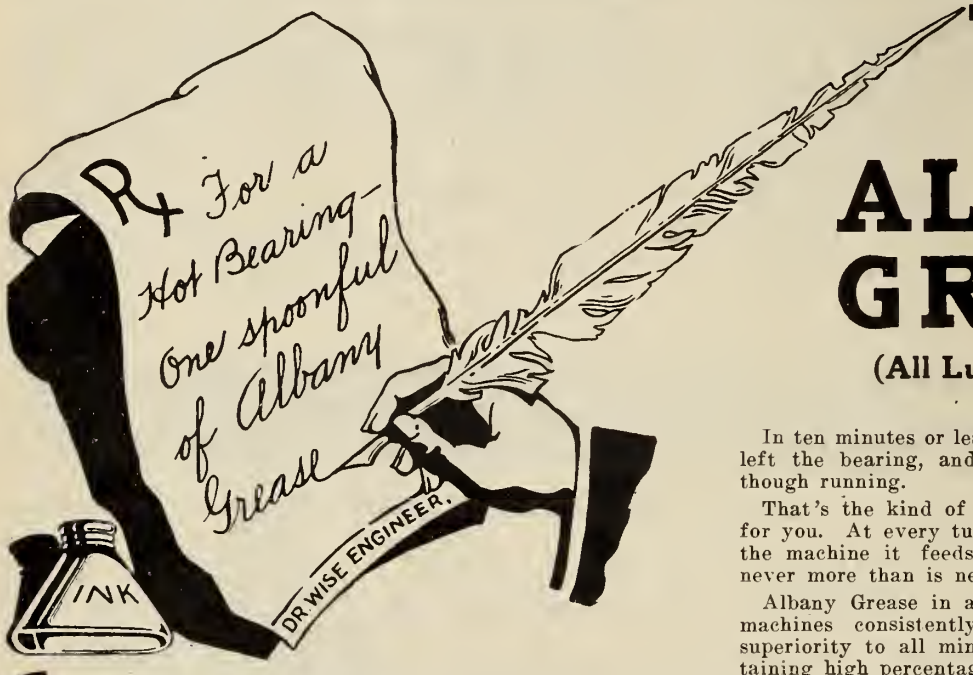
The Elmira Pulley is built to stand the hardest service and most severe conditions. The rim is nailed throughout. The arms are tenoned into the rim and dowelled there. The pulley is guaranteed to run wherever a leather belt will give satisfaction.

Send for our Illustrated Catalogue "C."

Large and complete stocks carried at Elmira, and by

The A. M. ELLICOTT CO., 301 St. James Street, Montreal, Que., Sole Eastern Agents.

Elmira Machinery & Transmission Co., Limited - - Elmira, Canada



ALBANY GREASE

(All Lubricant—No Waste)

In ten minutes or less you will find the "fever" has left the bearing, and that it is quite cool—even though running.

That's the kind of lubricating Albany Grease does for you. At every turn of the shaft or movement of the machine it feeds as the demand requires, but never more than is needed for perfect lubrication.

Albany Grease in actual tests on two oil testing machines consistently proved at all pressures its superiority to all mineral oil greases and those containing high percentages of lime soaps.

Albany Grease has a coefficient of friction which is slightly higher than pure lard oil. But the best way to prove this is to send for sufficient quantity of Albany Grease, an Albany Grease Cup and the book, "Death to Friction," and learn for yourself.

At your dealer—if not, order direct.

ALBANY LUBRICATING COMPANY

ADAM COOK'S SONS, Proprietors

708-710 Washington Street **New York, U. S. A.**

The advertiser would like to know where you saw his advertisement—tell him.

Cling-Surface Helps Even Belts Like These

If there were belts where Cling-Surface treatment would fail, you could reasonably figure that they would be the ones in conveyor service. A conveyor belt like those shown certainly gets violent use. It is hammered with rock, surrounded with dust and dirt, is subject to abrasion, must pull a heavy load while distorted in every direction, and must often resist every kind of weather that comes along. In fact, the work is too severe unless the belt is mighty well cared for.

The conveyor belts shown herewith are treated regularly on the pulley side with Cling-Surface, and in spite of their heavy load and the incline, they pull their load without slip. Further, the penetration of the Cling-Surface to each fibre and the constant saturation of the whole belt keeps it elastic, ready to give when struck by the material it carries, and ready to conform to the greatest practical area of each pulley. A belt made tough but yielding by Cling-Surface treatment also resists abrasion better than a hard, stiff one. The life and ability to carry heavy load are thus greatly increased, and these effects are doubled by the action of the Cling-Surface in keeping water out of the belt. You know moisture gets into the minute surface cracks of a hard belt much more easily than it gets out, and its continued presence within the belt invariably means rotted fibres and decreased strength. Cling-Surface keeps the belt permanently waterproof.

The fact that Cling-Surface treatment is highly successful in such extreme cases as this should be sufficient evidence that it will be at least as successful on ordinary driving belts where the conditions are all in its favor. A dollar's worth of Cling-Surface per year is rarely necessary, even on the largest engine or dynamo belt, to insure perfect belt service, and the cost of Cling-Surface and its application is practically nothing in comparison to the power loss, the belt deterioration, the hot boxes, the excessive lubrication, the ruined bearings and shafts, and the delays which it prevents. Consider your belt service as seriously as your engine economy, for it is every bit as important in the ultimate profits. A trial of Cling-Surface involves only our risk and your gain. We want no pay until you are convinced. Write for literature.

Cling Surface Co

1057 Niagara St Buffalo N Y

41

It is the service which you get out of your belting that determines its value to you ---not its "first cost."

"CLIMAX"

and

"AMPHIBIA"

(Waterproof)

Leather Belting

Costs less per day of service

This is the important fact to remember when in the market for belting.

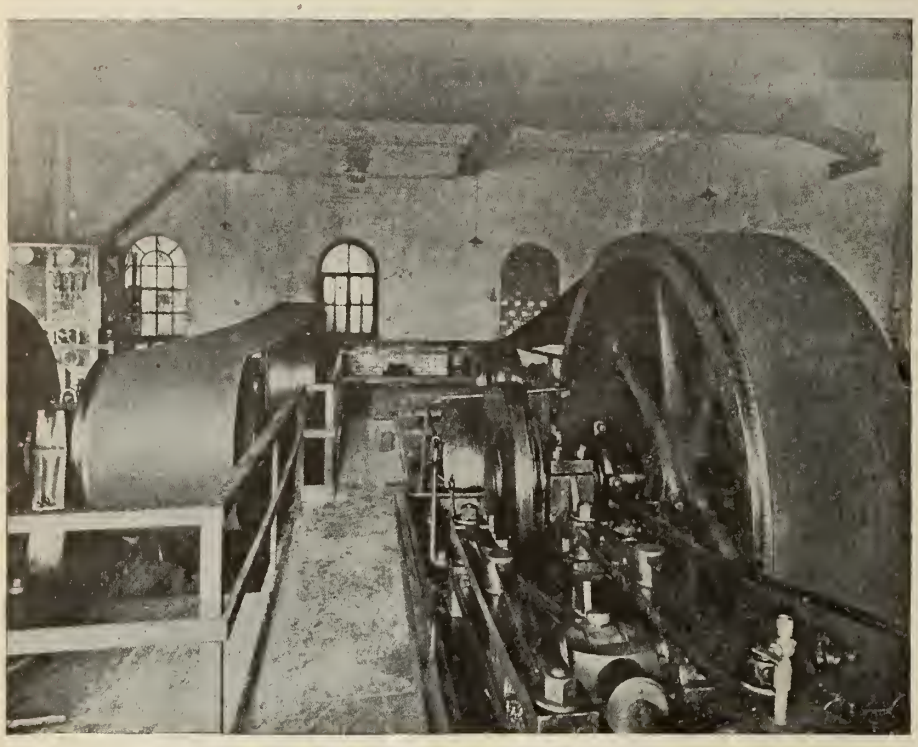
Sadler & Haworth

Tanners and Manufacturers

MONTREAL 511 William St.
TORONTO 27 Melinda St.
ST. JOHN, N.B. 89 Prince William St.
VANCOUVER 217 Columbia Ave.
WINNIPEG 244 Princess St.

For over 35 years the makers of the best leather belts.

Scandinavia Belting as a Main Drive Belt



Scandinavia Belting runs true. It is exceptionally strong.

For Main Drive belts, if you give us the particulars of the drive, we are willing to furnish you with a Scandinavia belt adaptable to your needs, with a distinct guarantee that Scandinavia belting will not only save you money in the long run, but will save you money in its first cost as well.

Write us for full particulars.

Federal Engineering & Supplies Limited

Toronto - Montreal

LOOKING FOR THE "MAPLE LEAF"

is increasingly a habit with those who buy much Belting.

The reason is not hard to find, for there is no part of your Belting system, from the main drive to the smallest light Belt for power transmission, where you will not get the best kinds of service from

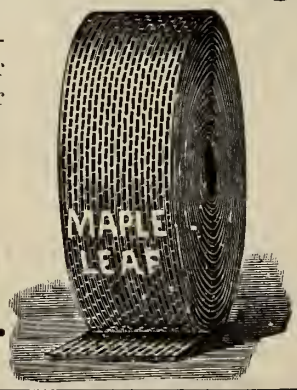
"MAPLE LEAF" BRAND Stitched Cotton Duck Belting

It is the most economical Belting because it is durable under every condition; even where other Belting will deteriorate rapidly. It is water proof.

It runs absolutely true on the Pulleys.

It is built of plies of selected duck.

Write for Information and Prices.



DOMINION BELTING CO., Ltd.
HAMILTON, CANADA

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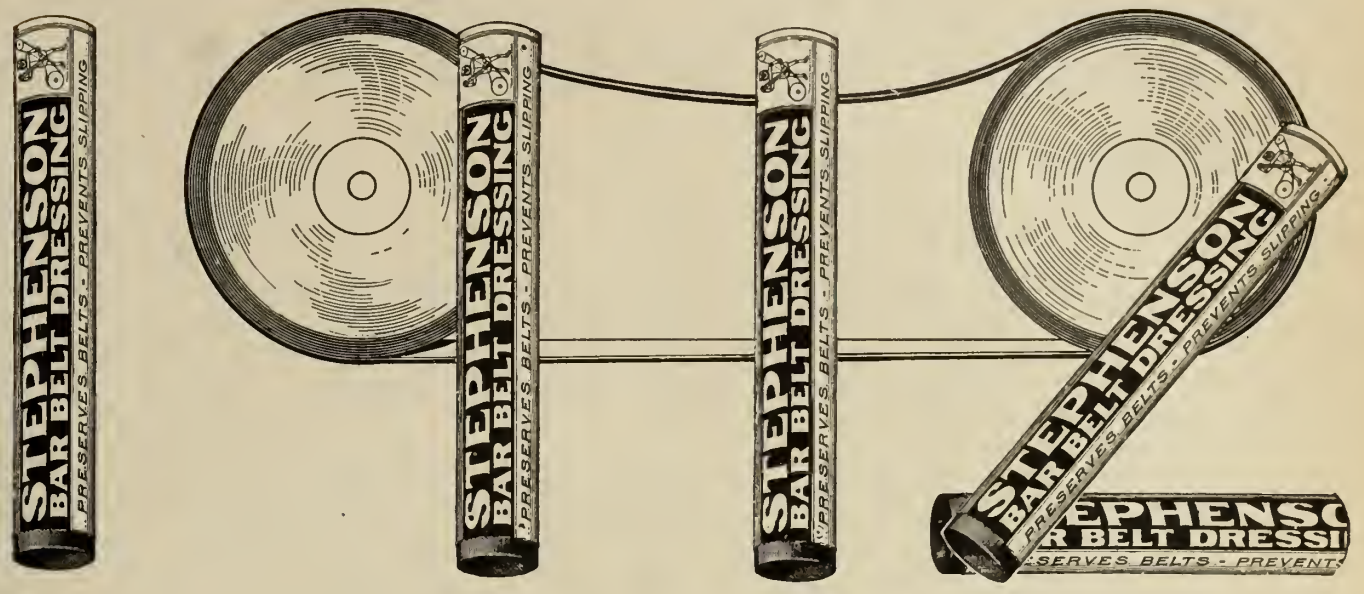
For



Use Stephenson Bar Belt Dressing

Make 1912 a record breaking year. Turn over a new leaf and get rid of the things that have been causing needless trouble and expense. Adopt the things which will make your work easier, give better results and save money for your employer. You cannot start at a better place than with your belt dressing.

Get rid of your troublesome liquid dressing. Shake the can for the Stephenson solid stick and shake trouble at the same time.

Stephenson Bar Belt Dressing is a friend in need. It doesn't require preparation, nor do you have to use special care in applying it. The minute the belt slips you hold the Stephenson bar to the belt for a few seconds and the slipping stops. There's no waste—no slop—no smearing on of paste or pouring on of spattering liquid. And the results are better.

I'll "Stick to the Solid Stick"

Start With a Free ½ Lb. Sample

Simply send us your name and address and we'll send you a present in the shape of a free half-pound sample of Stephenson Bar Belt Dressing.

Remember—we give you this sample absolutely free of charge. Get this free half-pound of the finest belt dressing made and test it. Here's your chance to try somesomething really good at no expense.

None Genuine Without Trade-Mark

Stephenson Manufacturing Company

Est. 1888 Albany, N.Y. Inc. 1897

The advertiser would like to know where you saw his advertisement—tell him.

Do You Want to Buy Something That You do Not Know Where to Get?

EVERY month The Power House receives letters from subscribers stating that they are in the market for certain articles, but that they do not know where they can be procured.

They ask us if we can tell them from what source they can procure the wanted articles. This is a service we render cheerfully.

When you become a subscriber to The Power House this service is part of what you buy.

We have facilities for procuring information about new appliances which have not been extensively advertised, and these facilities are at the service of our readers.

We are glad to get these requests for information and no service could be more cheerfully rendered.

CUT OUT THE COUPON BELOW, and use it when you would like us to give you information.

THE POWER HOUSE

143 University Avenue, Toronto

THE POWER HOUSE
143 UNIVERSITY AVENUE
TORONTO

For Subscribers

INFORMATION WANTED

DATE_____ 191

PLEASE TELL ME WHERE I CAN BUY _____

NAME _____

ADDRESS _____

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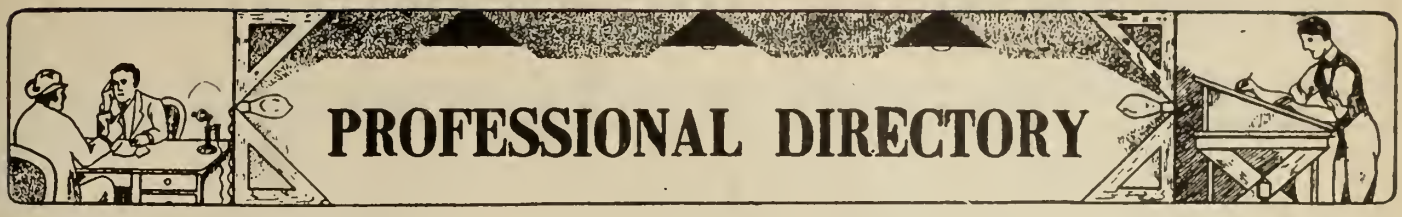

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Mechanical and Hydraulic Engineer
Green Fuel Economizer
Mechanical Draft Apparatus
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Plans, Specifications, Estimates, Tests, Reports and Supervision
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PRATT & ROSS
Industrial and Consulting Engineers, Etc.
Power House and Factory Design, Reinforced Concrete.
289 Garry Street - WINNIPEG, MAN

Fetherstonhaugh & Co.
Patents Trade Marks and Designs in all countries
Canada Life Bldg., MONTREAL

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AND TRADE MARKS obtained in all Countries.
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Indicating, valve-setting and general repairs on all kinds of engines.
RENOWN ENGINE & MACHINE CO.
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KENT BROTHERS
Miners and Exporters of
CANADIAN, AMBER MICA
Kingston Ont., - - Canada
Write us for your requirements in MICA

BAYFIELD & ARCHIBALD
CONSULTING MECHANICAL ENGINEERS
MOLSONS BANK BUILDING
P.O. Box 788 - Vancouver, B.C.

THE CANADIAN TURBINE WATER WHEEL
CONSERVE THE WATER POWERS
TRADE MARK.

Chas. Barber & Sons
Meaford : Ontario
WATER POWER EQUIPMENT ONLY
Write for Catalogue

HAVE YOU TRIED
MONCRIEFF'S "UNIFIC"
WATER GAUGE GLASSES?
They never corrode. They last longer.
They defy competition.
For full information apply to our Canadian Representative,
W. J. WALL,
134-136 Bleury St. - Montreal

PANEL BOARDS
made by
The Devoe Electric Switch Co.
are recommended by all First Class Electrical Engineers.
Send us your specifications.
157 Craig St. West, Montreal.

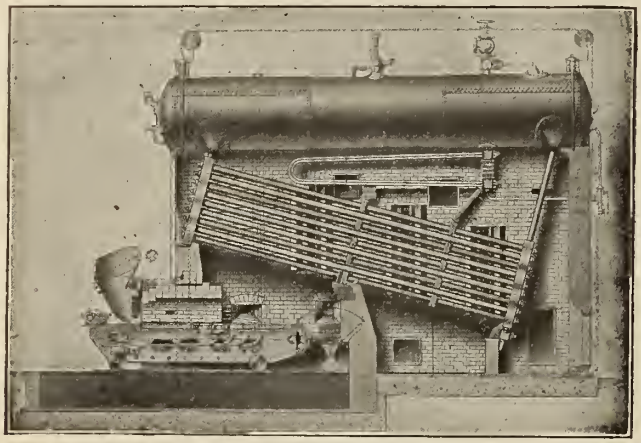
The advertiser would like to know where you saw his advertisement—tell him.

BABCOCK & WILCOX, Limited

"B. & W." PATENT WATER TUBE BOILERS

With Furnaces for all Classes of Fuel or Waste Gases

HIGHEST ECONOMY, SAFETY, DURABILITY OVER 8,000,000 IN USE



Babcock & Wilcox Patent Water Tube Boiler, Superheater and Mechanical Stoker

ALSO

Steam Superheaters
Mechanical Stokers
Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and **ELECTRIC CRANES**

Our Book "STEAM" sent on request

HEAD OFFICE FOR CANADA - COLLEGE ST. (ST. HENRY), MONTREAL

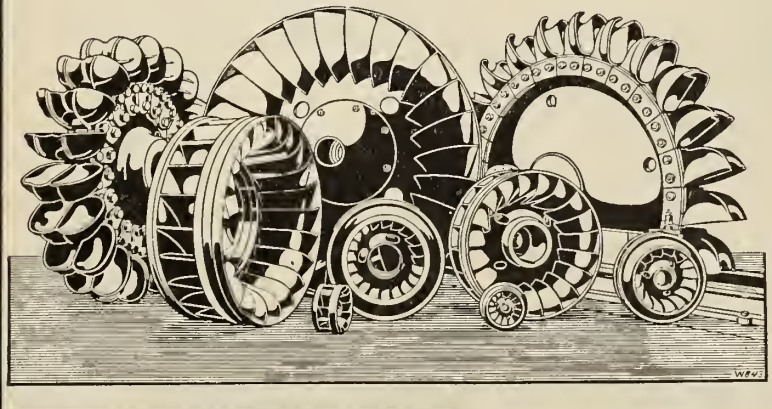
TORONTO OFFICE, TRADERS BANK BUILDING.

ESCHER-WYSS-WATER-WHEELS TURBINES AND IMPULSE-WHEELS

HEAD OFFICE FOR CANADA:

515 Canadian Express Bldg.,

MONTREAL, Que.



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MAN., SASK., ALTA.

C. L. Trimingham, 45 Canada Life Bldg., Winnipeg, Man.

BRITISH COLUMBIA:

Frank Darling & Co., Homer Street, Vancouver, B.C.

The advertiser would like to know where you saw his advertisement—tell him.

THE POWER HOUSE BUYERS' DIRECTORY

To our Readers:—Use this directory when seeking to buy power equipment or supplies. You will often get information that will save you money.

To our Advertisers:—Send in your name for insertion under the heading of the lines you make or sell.

To Non-Advertisers:—A nominal rate of $1 per line a year is charged non-advertisers.

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Can. Westinghouse Co., Hamilton.

Air Compressors and Receivers.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montréal.
Canada Fdry. Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.
Escher, Wyss & Co., Toronto.
Fraser & Chalmers, Ltd., Montreal.
Laurie & Lamb, Montreal.

Air Vents, Automatic.
Canadian Steam Boiler Equipmeut Co., Toronto.

Ammeters.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Can. Gen. Elec. Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.

Ammonia Fittings.
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Canadian Fairbanks-Morse Co., Ltd., Montreal.

Asbestos Specialties.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.

Automatic Electric Machinery.
Chicago Pump Co., Chicago.

Automatic Ice Recording Doors and Chutes.
Jones Cold Store Door Co., Hagerstown, Md.

Autogenous Welding.
Franco-Canadian Welding Co., Toronto.

Babbitt and Anti-friction Metal.
Canada Metal Co., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
General Supply Co. of Can., Ottawa.
Magnolia Metal Co., New York, N.Y.
Railway Equipment Co., Toronto.

Belt Dressing.
British Pac. Sup. Co., Victoria, B.C.
Cling Surface Co., Buffalo.
Jos. Dixon Crucible Co., Jersey City.
General Supply Co. of Can., Ottawa.
C. C. Snowdon, Calgary.
Stephenson Mfg. Co., Albany, N.Y.

Belt Tightеners.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
Waterous Engine Wks. Co., Brantford

Belting, Stitched Cotton Duck.
Dominion Belting Co., Hamilton, Ont

Belting, Leather.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Can., Ottawa.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
Sadler & Haworth, Montreal.

Belting, Rubber.
Dunlop Tire & Rubber Goods Co., Toronto.
General Supply Co. of Can., Ottawa.
Jeffrey Manufacturing Co., Columbus.
Quaker City Rub. Co., Philadelphia.

Belting, Scandinavia.
Federal Eng. & Supplies, Toronto.

Bending, Pipe.
National Pipe Bending Co., New Haven, Conn.

Bins, Coal, Coke and Ore.
Jeffrey Manufacturing Co., Columbus.

Blowers.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Escher, Wyss & Co., Toronto.
Fraser & Chalmers, Ltd. Montreal.
General Supply Co. of Can., Ottawa.
Hare Eng. Co., Toronto.

Boiler Compounds.
Can. Oil Companies, Ltd., Toronto.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
W. W. Carrnthers, Winnipeg, Man.
Dearborn Drug and Chemical Works, Chicago, Ill.
Electric Boiler Compound Co., Guelph, Ont.
Geo. W. Lord Co., Philadelphia, Pa.
McColl Bros. & Co., Winnipeg.
C. C. Snowdon, Calgary.

Boiler Compound Feeders
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Hare Eng. Co., Toronto.
Morehead Mfg. Co., Detroit, Mich.

Boiler Feed Pumps.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canada Fdry. Co., Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Deming Co., Salem, O.
Fraser & Chalmers, Ltd., Montreal.
General Supply Co. of Can., Ottawa.
Hare Eng. Co., Toronto.

Boiler Feed Regulators.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
General Supply Co. of Can., Ottawa.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.

Boiler Mountings.
Babcock & Wilcox, Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Lunkenheimer Co., Cincinnati, O.
H. L. Peiler & Co., Montreal.

Boiler Tube Cleaners.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg.
H. L. Peiler & Co., Montreal.
Vulcan Tube Cleaning Systems, Ltd., Montreal.

Boilers, Horizontal, Tubular and Watertube.
Babcock & Wilcox, Montreal.
Goldie & McCulloch Co., Galt.
Canada Fdry. Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Fraser & Chalmers, Ltd., Montreal.
General Supply Co. of Can., Ottawa.
Jenckes Machine Co., Sherbrooke, Que
Jones Underfeed Stoker Co., Toronto.
E. Leonard & Sons, London, Ont.
Ogilvy Eng. Co., Montreal.
Polson Iron Works, Toronto.
Robb Engineering Co., Amherst, N.S
Railway Equipment Co., Toronto.
Waterous Engine Wks. Co., Brantford

Boilers, Marine, Locomotive and Vertical.
Babcock & Wilcox, Montreal.
Goldie & McCulloch Co., Galt.
Canada Fdry. Co., Ltd., Toronto.
Fraser & Chalmers, Ltd., Montreal.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
Polson Iron Works, Toronto.
Robb Engineering Co., Amherst, N.S
Waterous Engine Wks. Co., Brantford

Boxes, Junction.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Buckets.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.

Cable Hangers and Supports.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Cables, Aerial and Underground.
Eugene F. Phillips Electrical Works, Ltd., Montreal.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Cable, Terminals.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Cans, Oily Waste.
Jas. Morrison Brass Mfg. Co., Toronto.

Car Movers and Pullers.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.

Cast Iron Fittings.
General Supply Co. of Can., Ottawa.

Castings, Brass and Iron.
Lunkenheimer Co., Cincinnati, O.
J. C. Wilson & Co., Glenora, Ont.

Cement, Fireproof.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.

Cement Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.

Chemicals.
Dearborn Drug and Chemical Works, Chicago.
C. C. Snowdon, Calgary.

Circuit-Breakers.
Can. Gen. Elec. Co., Ltd., Toronto.
Can. Westinghouse Co., Hamilton.

Clutches.
Elmira Machinery and Transmission Co., Elmira.
General Supply Co. of Can., Ottawa.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
Waterous Engine Wks. Co., Brantford

Coal and Ash Conveyors.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Ltd.
Hare Eng. Co., Toronto.
Jeffrey Mfg. Co., Columbus, O.
H. L. Peiler & Co., Montreal.
Geo. H. Tod, Toronto.

Coal Handling Machinery.
Ed. Bemis & Co., Ltd.
Hare Eng. Co., Toronto.
Geo. H. Tod, Toronto.
Jeffrey Manufacturing Co., Columbus.

Cold Storage Architects.
E. J. Greenstreet, Toronto.

Cold Storage Insulation.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.

Condensers.
Alberger Condenser Co., New York.
American Steam Pump Co., Battle Creek, Mich.
Canada Fdry. Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Fraser & Chalmers, Ltd., Montreal.
Goldie & McCulloch Co., Galt.
H. L. Peiler & Co., Montreal.
Hare Eng. Co., Toronto.
Waterous Engine Wks. Co., Brantford

Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Condensation Receiver.
G. M. Davis Regulator Co., Chicago.

Conduits.
E. Leonard & Sons, London, Ont.
Can. H. W. Johns-Manville Co., Toronto.

Consulting Engineers.
Bayfield & Archibald, Vancouver, B.C
Chas. Bishop, M.I.C.S.A., Montreal.
de Gaspe Beaubien, Montreal.
W. N. Dietrich, Montreal.
John T. Farmer, Montreal.
Fetherstonhaugh & Co., Montreal.
Walter J. Francis, Montreal.
Jacobs & Davies, Inc., Montreal.
Pratt & Ross, Toronto.
J. M. Robertson, Montreal.
J. M. Shanly, Montreal.
A. V. Tracy-Gould, Montreal.

Contractors, Structural Steel.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canada Fdry. Co., Ltd., Toronto.

Conveyor Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Columbus.
Waterous Engine Wks. Co., Brantford

Cooler Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Cooling Towers.
Alberger Condenser Co., New York.

Copper Rods.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Cork Insulation.
Can. H. W. Johns-Manville Co., Toronto.

Cotton Hose.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia.

Couplings.
Canadian Boving Co., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Dunlop Tire and Rubber Goods Co., Toronto.
Elmira Machinery and Transmission Co., Elmira.
General Supply Co. of Can., Ottawa.
Jeffrey Manufacturing Co., Columbus.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
J. C. Wilson & Co., Glenora, Ont.

Cranes, Electric.
Babcock & Wilcox, Montreal.
Canada Fdry Co., Ltd., Toronto.

Crank and Crosshead Pin Oilers
Lunkenheimer Co., Cincinnati, O.

Crushing Machinery.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canada Foundry Co., Ltd., Toronto.
Fraser & Chalmers, Ltd., Montreal.

Damper Regulators.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago, Ill.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
H. L. Peiler & Co., Montreal.

Doors, Cold Storage and Freezer.
Jones Cold Store Door Co., Hagerstown, Md.

Drying Machinery.
Can. Fairbanks-Morse Co., Montreal.

Dynamos.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Economizers.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.

Ejectors.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Electric Fans.
Canadian General Electric Co., Ltd., Toronto.

Electrical Accessories and Machinery.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Canadian H. W. Johns-Manville Co., Toronto.
Monarch Electric Co., St. Lambert, Que.
Northern Electric & Mfg. Co., Limited Montreal.
Railway Equipment Co., Toronto.

Electric Railway Equipment.
Railway Equipment Co., Toronto.

Elevating Machinery.
Can. Fairbauks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Columbus.
Waterous Engine Works Co., Brantford.

Engineers' Supplies.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Engines, Automatic and Drop Valve.
Fraser & Chalmers, Ltd., Montreal.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
Fraser & Chalmers, Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Gas and Gasoline.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto
Canadian Westinghouse Co., Hamilton.
Fraser & Chalmers, Ltd., Montreal.
General Supply Co. of Canada, Ottawa
Keighley Gas Engine Co., Keighley, Eng.
E. Leonard & Sons, London, Ont.
John Robson (Shipley) Ltd., Shipley, Eng.

Engines, High Speed, Steam.
Canadian Boving Co., Toronto.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.
Railway Equipment Co., Toronto.

Engines, Marine.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
General Supply Co. of Canada, Ottawa
E. Leonard & Sons, London, Ont.
Laurie & Lamb, Montreal.

Engines, Saw Mill.
Fraser & Chalmers, Ltd., Moutreal.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Single, Compound and Triple Expansion.
Canadian Boving Co., Toronto.
Fraser & Chalmers, Ltd., Montreal.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Kerr Engine Co., Walkerville.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.
Railway Equipment Co., Toronto.

Engines, Vertical.
General Supply Co. of Canada Ottawa
Laurie & Lamb, Montreal.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Railway Equipment Co., Toronto.

Exhaust Fans.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.

Exhanst Heads.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
The Sims Co., Erie, Pa.
Steam Appliance Co., Milwaukee, Wis.
Watson & McDaniel Co., Philadelphia

Expansion Joints.
Alberger Condenser Co., New York.
Lunkenheimer Co., Cincinnati, O.

Feed Water Alarms.
H. L. Peiler & Co., Montreal.

Feed Water Analyser.
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C. C. Snowdon, Calgary.

Feed Water Heaters.
Alberger Condenser Co., New York.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
National Pipe Bending Co., New Haven, Conn.
H. L. Peiler & Co., Montreal.
Robb Engineering Co., Amherst, N.S.
The Sims Co., Erie, Pa.
Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Canada Foundry Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.

Fire Hose.
Dunlop Tire and Rubber Goods Co., Toronto.
Quaker City Rubber Co., Philadelphia, Pa.

Fire Brick.
Alex. Gibb, Montreal.

Fireproof Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Flanges.
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General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.

Flue Brushes.
General Supply Co. of Canada, Ottawa
Steam Appliance Co., Milwaukee, Wis.

Flumes, Steel.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
E. Leonard & Sons, London, Ont.

Freezer Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Insulators.
Ed. Bennis & Co., Ltd.
Geo. H. Tod, Toronto.

Furnace Linings.
Hare Eng. Co., Toronto.

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Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto.

Gaskets, Rubber, Asbestos and Copper.
Can. Gasket Co., Bridgeburg, Ont.
Goetze-Gasket & Packing Co., New Brunswick.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Dunlop Tire and Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Canada, Ottawa

Gas Exhausters.
Hare Eng. Co., Toronto.

Gas Producer Plants.
Canadian Boving Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Fraser & Chalmers, Ltd., Montreal.
E. Leonard & Sons, London, Ont.

Gauge Cocks.
Can. Fairbanks-Morse Co., Montreal.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
H. L. Peiler & Co., Montreal.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

Gauges—Pressure, Vacuum, Draft and Recording.
Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.
H. L. Peiler & Co., Montreal.

Gears, Cut, Worm, Mortise.
J. C. Wilson & Co., Glenora, Ont.

Gears, Spur Level.
Manitoba Bridge & Iron Works Limited, Winnipeg.
J. C. Wilson & Co., Glenora, Ont.

Generators.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal.

Governors, Water Wheel
J. C. Wilson & Co., Glenora, Ont.

Graphite.
Jos. Dixon Crucible Co., Jersey City.
General Supply Co. of Canada, Ottawa
C. C. Snowdon, Calgary.

Graphitol.
British Pacific Supply Co., Victoria, B.C.

Grates.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Ltd.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.
Geo. H. Tod, Toronto.

Grease Cups.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
Detroit Lubricator Co., Detroit.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
F. J. Schuch, Toronto.

Grease and Oil Extractors.
Canada Foundry Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary.
Hare Eng. Co., Toronto.
Steam Appliance Co., Milwaukee, Wis.

Greases.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria, B. C.
Can. Fairbanks-Morse Co., Montreal.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Hangers.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Heaters.
Alberger Condenser Co., New York.
Canada Foundry Co., Toronto.
Darling Bros., Montreal.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Hare Eng. Co., Toronto.
E. Leonard & Sons, London, Ont.
H. L. Peiler & Co., Montreal.
The Sims Co., Erie, Pa.

Hose, Flexible Metallic.
F. J. Schuch, Toronto.

Hose, Steam, Suction and Water.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.

Hydraulic Accumulators.
Canada Foundry Co., Ltd., Toronto.

Hydraulic Machinery.
The Deming Co., Salem, O.

Hydro Extractors.
Jones & Glassco, Montreal,

Ice Making Machinery.
Linde British Refrigeration Co., Montreal.

Indicators, Electric—All Types.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Indicators, Steam and Gas Engine.
Can. Fairbanks-Morse Co., Montreal.
H. L. Peiler & Co., Montreal.
The Maihak Indicator Agy., Montreal.

Indicators—Ammonia, Hydraulic.
Detroit Lubricator Co., Detroit.

Indicating.
Renown Engine & Machine Co., Montreal.

Injectors.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.

Insulating Compounds.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Insulating Tapes & Varnishes.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Furnaces.
Monarch Electric Co., St. Lambert, Que.

Iron Filler.
Imperial Waste & Metal Co., Montreal.

Lamps, Tungsten, etc.
Canadian General Electric Co., Ltd., Toronto.

Lamps, Arc, Incandescent.
Canadian General Electric Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton
P. H. Klein, Jr., Co., Montreal.
Northern Electric & Mfg. Co., Limited, Montreal.
A. H. Winter Joyner, Toronto.

Lubricants.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria,
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Lubricators, Force Feed.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
Darling Bros., Montreal.
Can. Detroit Lubricator Co., Windsor,
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N.Y.

Lubricators, Plain.
Can. Detroit Lubricator Co., Windsor, Ont.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.

Mats.
Dunlop Tire & Rubber Goods Co., Toronto.

Mechanical Stokers.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Ltd.
Fraser & Chalmers, Ltd., Montreal.
Hare Eng. Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.

Metal Cutting (Oxy-Hydrogen).
Franco-Can. Welding Co., Toronto.

Metal Welding.
Franco-Can. Welding Co., Toronto.

Meters, Electric.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Monarch Electric Co., St. Lambert, Que.

Meters, Water.
H. L. Peiler & Co., Montreal.

Mica.
Kent Brothers, Kingston, Ont.

Mill and Mining Machinery.
Can. Fairbanks-Morse Co., Montreal.
Fraser & Chalmers, Ltd., Montreal.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
Jenckes Machine Co. Sherbrooke, Que
Robb Engineering Co., Amherst, N.S.
Railway Equipment Co., Toronto.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Motors.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal.
Railway Equipment Co., Toronto.

Motor Starters and Controllers.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Office Railings.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Cups.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
Can. Detroit Lubricator Co., Windsor,
Lunkenheimer Co., Cincinnati, O.

Oil Filters.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Jas. Morrison Brass Mfg. Co., Toronto.
The Sims Co., Erie, Pa.

Oil Separators, Ammonia.
Steam Appliance Co., Milwaukee,

Oil Separators.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Liberty Mfg. Co., Pittsburg.
Jas. Morrison Brass Mfg. Co., Toronto.
Steam Appliance Co., Milwaukee

Oils, Lubricating.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria
Can. Oil Companies, Ltd., Toronto.
Dearborn Drug and Chemical Works Chicago.

C. C. Snowdon, Calgary.

Oxy-Acetylene Welding.
Franco-Can. Welding Co., Toronto

Packing Engine.
Can. H. W. Johns-Manville Co., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Canada, Ottawa
Steel Mill Packing Co., Windsor, Ont.

Packing, Metallic.
General Supply Co. of Canada, Ottawa
Holmes Metallic Packing Co., Wilkesbarre, Pa.
H. L. Peiler & Co., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.
Rhodes Improved Metallic Packing Co., Ltd., Montreal.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
General Supply Co. of Canada, Ottawa
Steel Mill Packing Co., Windsor, Ont

Packing, Sheet.
Dunlop Tire & Rubber Gods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
General Supply Co. of Canada, Ottawa
Quaker City Rubber Co., Philadelphia, Pa.
F. J. Schuch, Toronto.

Packing, Ammonia, Steam and Water.
Canadian H. W. Johns-Manville Co., Toronto.
Dunlop Tire and Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
General Supply Co. of Canada, Ottawa
Quaker City Rubber Co., Philadelphia, Pa.
F. J. Schuch, Toronto.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rubber.
Dunlop Tire and Rubber Goods Co., Toronto.

Panel Boards.
Devoe Electric Switch Co., Montreal.
Hill Electric Switch Co., Montreal.

Packing Rubber.
Dunlop Tire and Rubber Goods Co., Toronto.

Patents.
Rowland Brittain, Vancouver, B.C.

Penstocks.
Canada Foundry Co., Ltd., Toronto.
Canadian Booving Co., Toronto.

Penstock Lugs.
Otterville Mfg. Co., Otterville, Ont.

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Iron Work for Dumps,
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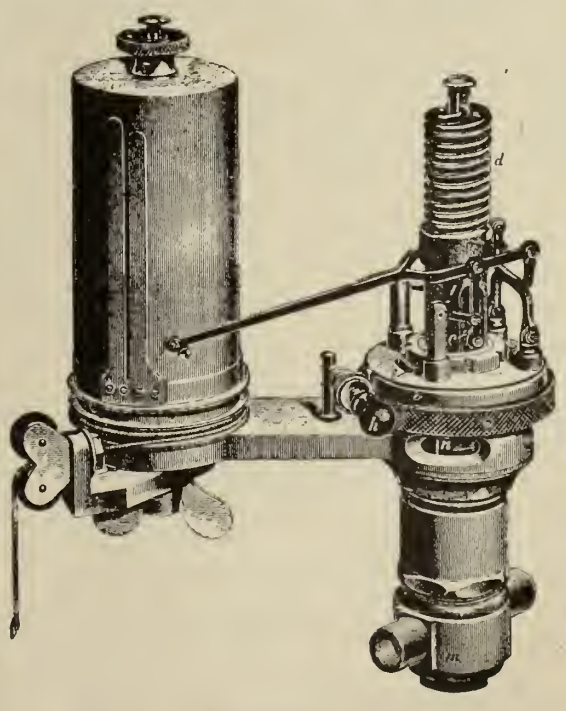

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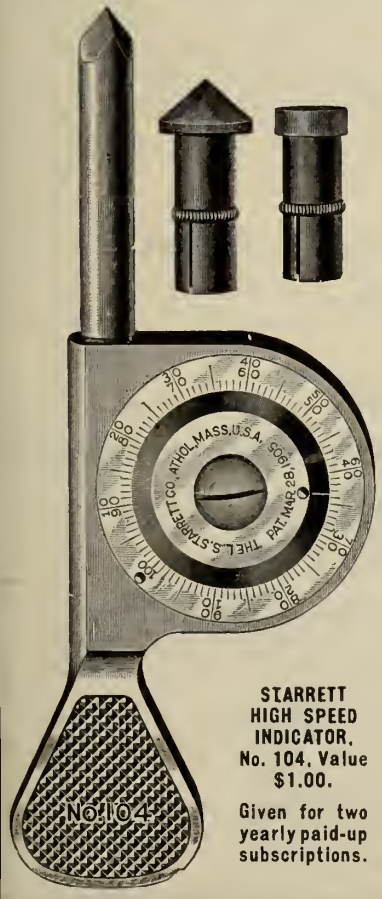

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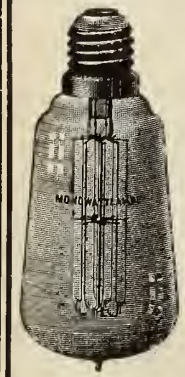

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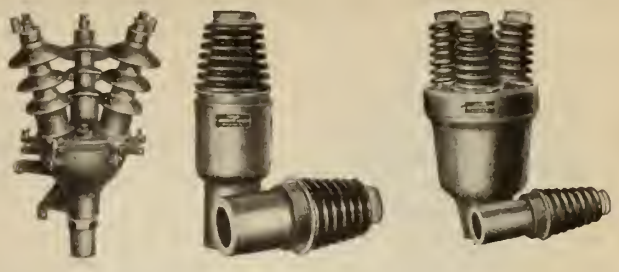

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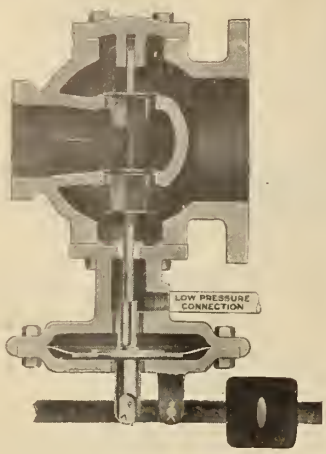

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Westinghouse Synchronous Motors

Westinghouse Pedestal Bearing Synchronous Motor with Direct-Connected Exciter

THE line of Westinghouse Synchronous Motors covers not only "Synchronous Condensers" for floating unloaded on the line for power factor correction, but also machines intended to carry mechanical loads up to their rated capacity when operating at 100 per cent. power factor, and are suitable for a belted or a direct-connected load as dictated by speed considerations.

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Voltages of 400, 600, 1200 and 2400 have been standardized throughout the line, but information for other voltages may be obtained by applying to our nearest office.

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Traders Bank Bldg.

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52 Victoria Square

OTTAWA
Ahearn & Soper, Ltd.

HALIFAX
Telephone Bldg.

WINNIPEG
158 Portage Ave. E

CALGARY
311 8th Ave. W.

VANCOUVER
Bank of Ottawa Bldg,

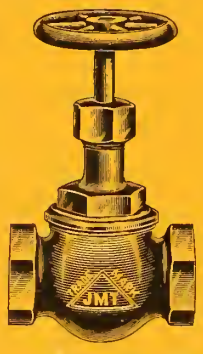
We have every requirement for your

STEAM HEATING SYSTEM

TRADE MARK J.M.T. REGISTERED A GUARANTEE OF QUALITY

J. M. T. REDUCING PRESSURE VALVE

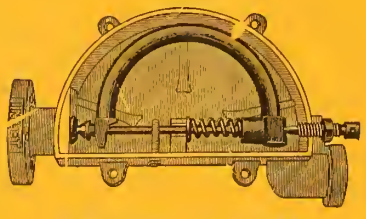
This is a valve that the engineer invariably chooses. Made from the highest grade material. Always gives splendid service.



J. M. T. VALVE

Made in Globe, Angle and Check Patterns.

The best valve for all-round service.



HEINTZ STEAM TRAPS

A Thermostatic Trap, operates at a variation of one degree of temperature, simplicity in construction, can be placed in any position. The ideal trap for heating coils, and machines operated by steam. They automatically relieve all condensation. Thousands in daily use.

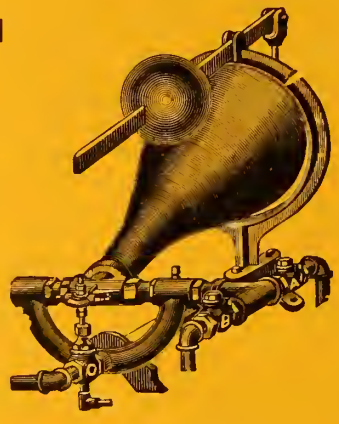
The present is the time when repairs to heating systems is given attention or new installations or extensions made, but before you do so, get familiar with our lines. **Our goods are absolutely guaranteed** to give a long, economical and efficient service — they are the **result of wide experience and best material.**

When you buy from us you get goods from a firm which has a **long retained reputation for quality**—you get **Prices** that are **Right.**

We do business on the re-order basis. If goods are not as represented money will be refunded.

Get in touch with us at once.

Write for Catalog and Full Particulars.



Bundy Return Steam Trap

At Reduced Price

This is an **opportunity to save money** and at the same time buy a **strictly high grade trap.** The **Bundy** is well and favorably known among steam users and has **a record of good service. Don't miss this opportunity.**

THE JAMES MORRISON BRASS MFG. CO., LIMITED

93-97 Adelaide Street West, Toronto

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143 149 University Ave. LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. V. Publication Office, Toronto—October, 1912 No. 10

ON THE WAY

ANOTHER NEW

TRADE PENBERTHY MARK.

HIGH GRADE LINE

Will Appeal to all Practical Engineers

Watch for it in NOVEMBER POWER HOUSE

ECLIPSE SECTIONAL RAINBOW GASKET

YOU WILL FIND IT ALL OVER THE WORLD

WHEREVER PACKING IS SOLD. IF YOU INSIST YOU CAN SECURE THE GENUINE ECLIPSE TUBULAR GASKETS MADE OF THE CELEBRATED RAINBOW COMPOUND. THESE GASKETS CAN BE USED OVER AND OVER, AND THE USE OF SAME MEANS ECONOMY IN THE ENGINEERING DEPARTMENT.

MANUFACTURED EXCLUSIVELY BY

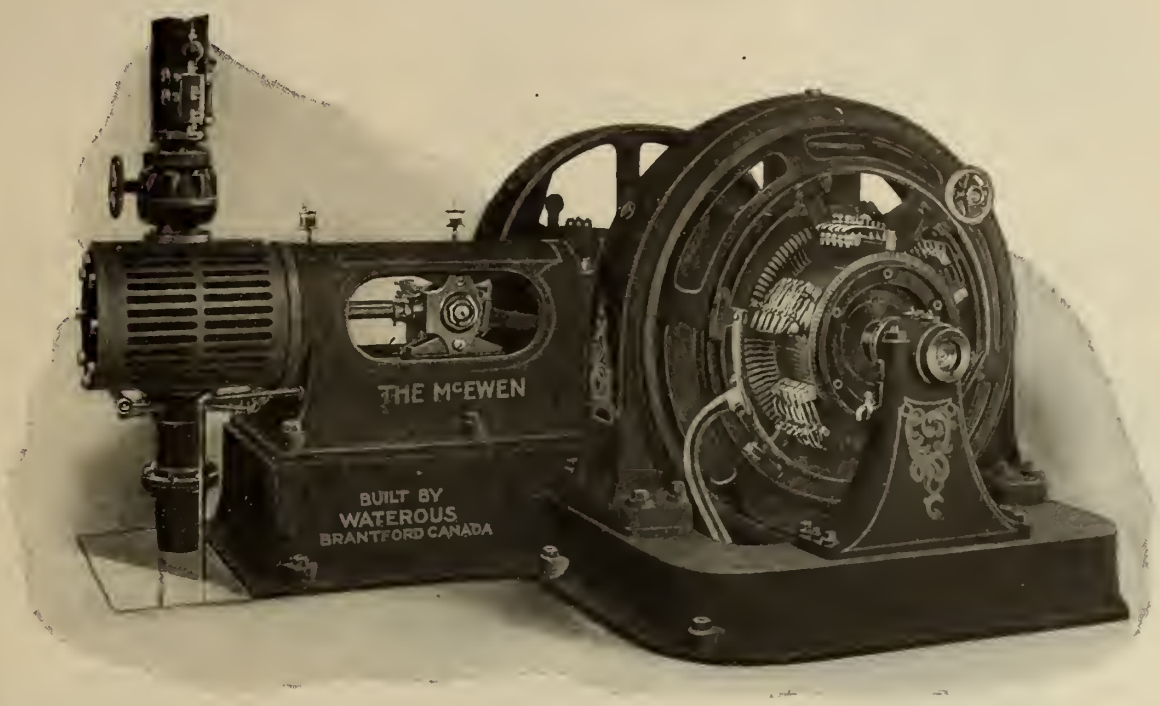
PEERLESS RUBBER MANUFACTURING COMPANY

16 WARREN STREET, NEW YORK

H. D. EDWARDS & CO.

DETROIT, MICH.

Sole Agents and Distributors for the Dominion of Canada.



The McEwen Engine

THE simplest and strongest high-grade engine on the market. The McEwen is fitted with an automatic fly-wheel governor--the Begthrup--that has never been surpassed for closeness and speed of regulation. It will govern within the limit of one revolution without difficulty. Built in simple and compound units up to 700 H.P.--the ideal installation for the isolated plant.

Send for the McEwen Booklet.

The Waterous Engine Works Co., Ltd.

BRANTFORD, CANADA

The advertiser would like to know where you saw his advertisement—tell him.

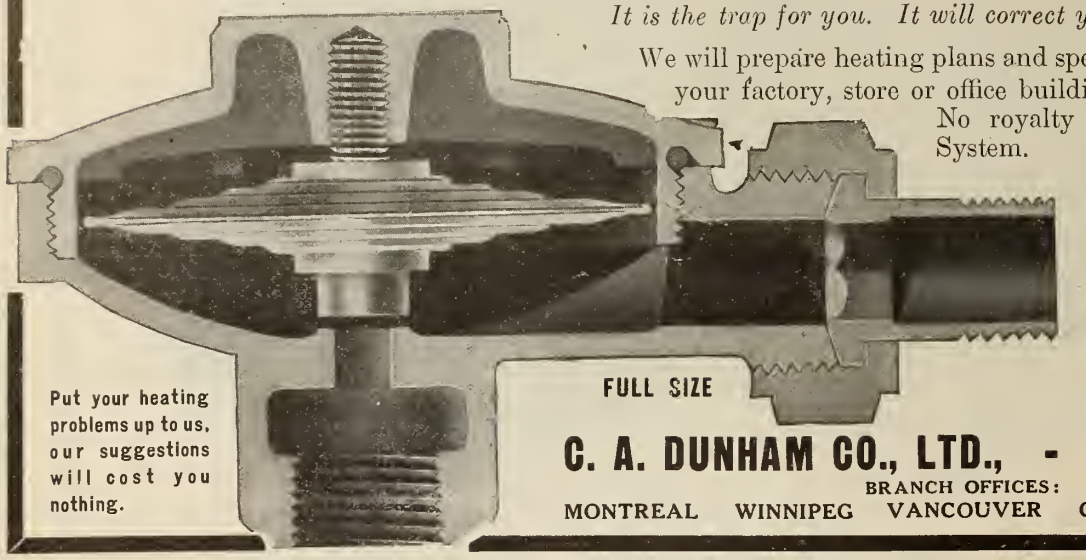
DUNHAM RADIATOR STEAM TRAPS
for VACUUM STEAM HEATING

A positive acting trap. Opens to discharge air and water and closes tight against steam at any pressure from 10 in. vacuum to 10 lbs. pressure. No adjusting for different steam pressure. Steam coming in direct contact with the disc vaporizes fluid on inside, which pressure bulges out the disc, shutting off the valve. This pressure against seat is sufficient to squeeze out any grease which might be on the seat.

Impossible for trap to clog up, because of large valve opening.

It is the trap for you. It will correct your heating troubles.

We will prepare heating plans and specifications for heating your factory, store or office building at no cost to you. No royalty charge for Dunham System.



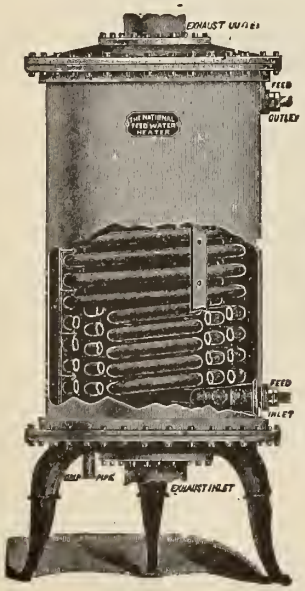
FULL SIZE

Put your heating problems up to us, our suggestions will cost you nothing.

C. A. DUNHAM CO., LTD., - TORONTO, ONT

BRANCH OFFICES:
MONTREAL WINNIPEG VANCOUVER CALGARY EDMONTON

Decreased Fuel Expense Means Increased Prosperity



It requires a considerable amount of fuel to heat your feed water to a boiling point if it is fed cold. **You can make your exhaust steam practically** boil this feed water if you install the

"NATIONAL" FEED-WATER HEATER

Think what a **saving in fuel** this would mean to YOU in a year—enough to more than pay for the heater.

Back Pressure, Corrosion or leakages are impossible with this heater. **It cannot get out of order.** The **simplicity** and **durability are** strong features.

Write at once for full particulars.

The National Pipe Bending Company
91 Lloyd Street, New Haven, Conn., U.S.A.

POWER BOILERS

Horizontal Tubular, Vertical Tubular and Locomotive Types.
In all sizes, and for medium or high pressures.

Our Boiler Catalogue No. 112, sent promptly on request.

The Jenckes Machine Co., Limited

General Offices: Sherbrooke, Que.

Works: Sherbrooke, Que. St. Catharines, Ont.

Sales Offices:—Sherbrooke, Montreal, St. Catharines, Cobalt, So. Porcupine, Vancouver, Nelson.

Sales Over Five Million Dollars Annually

Four Babbitt Manufacturing Plants

TORONTO LONDON, ENG. NEW YORK ST. LOUIS

Faultless "A" This babbitt is a high grade copper hardened alloy, possessing in a higher degree all the good points of the original Genuine Babbitt, with increased antifriction qualities, having the additional merit of absorbing and holding oil. It is used extensively in France for automobile engines, and in South Africa for mining machinery, and in United States and Canada for marine engines, dynamos and all heavy duty machines. Where heavy service is required this will last longer than any Genuine Babbitt manufactured. For heavy duty, saw mills and engines it is without equal.

Eagle "A" Thousands of tons of this alloy have been placed on the market, giving such perfect results, that it's name and merits are known, we believe, as extensively as any other babbitt manufactured. It's high antifriction and heavy duty qualities make it especially adapted for saw-mills, planing-mills, threshing engines, traction engines, pumps, rolling-mills and general machine shop use.

HOYT METAL COMPANY

TORONTO OFFICE AND MFG. PLANT—EASTERN AVE. AND LEWIS ST.

The advertiser would like to know where you saw his advertisement—tell him.

MADE IN CANADA

The Lowest in Cost and Best

High Pressure Gaskets

On the Market

Because 1. They are permanent. 2. They are easy to apply. 3. They are easy to remove. 4. It is impossible to blow them out. 5. They will not stick to the metal. 6. They can be used over again. 7. They are not affected by high temperature. 8. Cleaning the joints after using these gaskets is unnecessary. 9. There is no danger of of damaging the gaskets in breaking or making the joint over. 10. There is no time lost in preparing these gaskets for the joint. They are always ready.

Write us at once for circulars and prices, and avoid duty.

CANADIAN GASKET COMPANY
BRIDGEBURG, ONT.

The Morehead Condenser Trap makes its own Vacuum

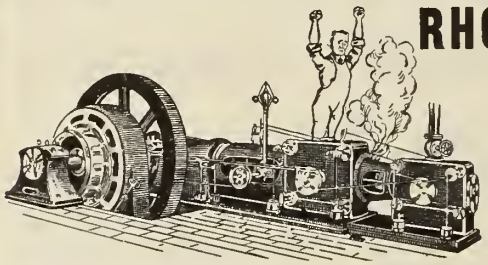
and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars and a Trial Trap.

Canadian Morehead Mfg. Co.
WOODSTOCK, ONT.

RHODES IMPROVED METALLIC PACKING

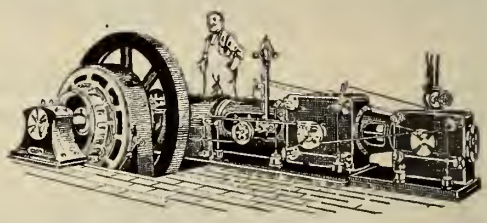


This was BEFORE he used our packing.

THE PACKING THAT PACKS

A trial will convince you.

Beware of Imitations.



This is AFTER he installed our packing.

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited
55 St. Francois Xavier Street, - - - MONTREAL

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

STEEL MILL PACKING CO. : WINDSOR, ONT.

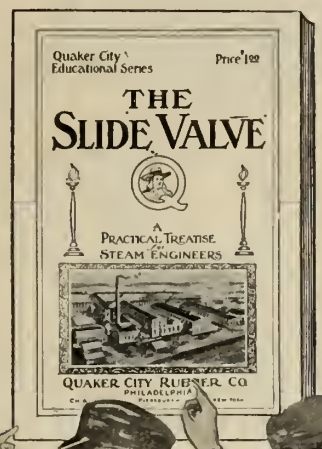
Practically Frictionless

Sold on APPROVAL

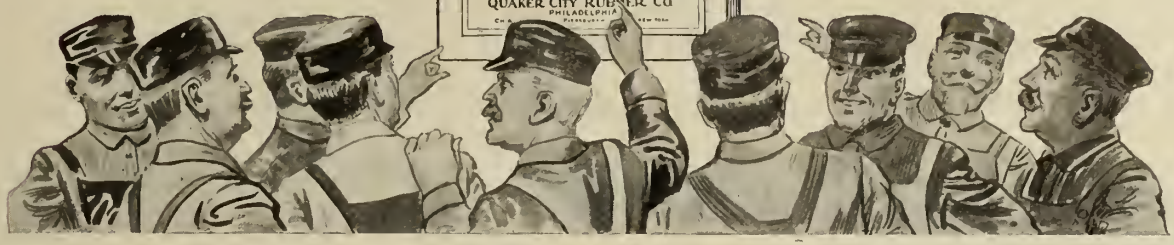
The advertiser would like to know where you saw his advertisement—tell him.

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY

"THE SLIDE VALVE"



A NEW BOOK FREE



Every Engineer Wants It

The valve is the "soul" of the steam engine. No man is really an engineer until he understands both the theory and practice of the valve. This book—given FREE—was written by a leading English authority and revised and Americanized by a noted American mechanical engineer. The present edition is but 3,500 copies. Send for yours TO-DAY.

DANIEL'S ROD PACKING **P. P. P.** COIL RING SPIRAL

How To Get The Valve Book FREE

Fill out the Coupon, and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and look at Daniels' P. P. P. Packing.

Your Name .....
Address .....
Employed by .....
Address .....
Horsepower of Engine .....
Kind of Rod Packing Used .....
Do you use EBONITE Sheet Packing? .....
Dealer's Name .....
Address ..... Series 24-J

If your dealer doesn't carry P. P. P. we will write telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

saves up to 4 per cent. of the engine's power —NO unnecessary FRICTION is the reason. P. P. P. makes rod as smooth as glass. It is lubricated with the finest lubricants.

FREE to Users of P.P.P.

If you are a user of P.P.P., fill out the coupon and mail it to us. We will send "The Slide Valve" Book to your dealer (or the one we name), who will hand it to you when you call at his store and look at Daniel's EBONITE Sheet Packing.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods
PHILADELPHIA, PA., U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

GOETZE'S VALVE GASKETS SAVE TROUBLE AND MONEY

THEY ARE FOR VALVES OF THE JENKINS TYPE
AND ARE MADE OF COPPER AND ASBESTOS

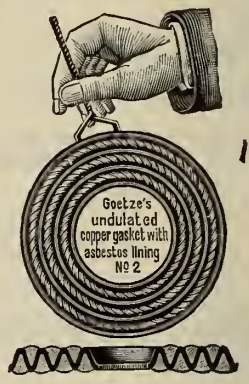
One Goetze's Valve Gasket will outlast six rubber discs, because it will not crack and go to pieces as rubber does. That's why Goetze's Valve Gaskets are cheapest from beginning to end.

Order your new valves fitted with Goetze's Valve Gaskets and have no more trouble with leaks. Use Goetze's Valve Gaskets to give your old valves a new lease of life. Only be sure you get *Goetze's.*

That Joint That Gives You So Much Trouble Can Be Made *Tight*

To put a gasket on the least troublesome flange joint in your plant is no real test of the value of that gasket. Put it on the *worst* joint, the one that is always giving you trouble, and you'll find out whether it is any good for your purpose or not.

We tell you that you can put a complete stop to all trouble due to leaky flange joints, that you can make that joint which gives you so much trouble absolutely tight



By Using Goetze's No. 2 Gaskets

And we are willing to prove it to you by shipping you any quantity on *90 davs' trial*—no charge if they do not make tight joints and *hold* them tight under all pressures and temperatures. Try them. Write us to-day what sizes and quantities to ship. Remember, they do not cost you a cent unless they do the work. And be sure to ask for a copy of our Illustrated Catalog of Packings for all Power Plant Purposes.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

St. John, N.B.

BRANCHES AT

MONTREAL
70 Cedar Ave.

WINNIPEG
C. E. Chown, 147 Bannatyne Ave.

VANCOUVER
A. O. Campbell, 1069 Hamilton St.

MANUFACTURED BY

Goetze Gasket & Packing Co.

NEW BRUNSWICK, N.J.

TRADE MARK

THE GARLOCK PACKING CO. HAMILTON, CANADA.

GARLOCK PACKINGS

On account of their superior qualities, are recognized as a standard packing for use under all conditions of service. Our Trade-mark is the passport by which we are known to those in need of reliable goods.

We have Packings to meet every requirement, and all you have to do is to write for information.

Garlock High Pressure Ring

Our handsomely illustrated catalog, descriptive of Garlock Packings and Pipe Coverings will be mailed on request.

Garlock Asbestos Gasket

"POINEERS IN THE PACKING BUSINESS."

The Garlock Packing Co.

Head Office and Works: HAMILTON, ONT.

Branches: MONTREAL, QUE., 412 St. James Street.
TORONTO, ONT., 77 Adelaide Street East.
WINNIPEG, MAN., 117 Market Street East.

TRADE JENKINS MARK
Jenkins Bros

Here's a Catalog

You Ought to have—

The new Jenkins Bros. Catalog for 1912

It shows some new types of valves, including the new TYPE "K" brass and iron body gate valves; cast steel valves of extra heavy patterns for superheated steam and hydraulic service, extra heavy check and blow-off valves, automatic equalizing stop and check valves, additional styles of radiator valves—

As well as the standard Jenkins Bros. types you have known and used for years.

Compact—handy—brimful of information for the man who's interested in valves, packing and other mechanical rubber goods for the power plant.

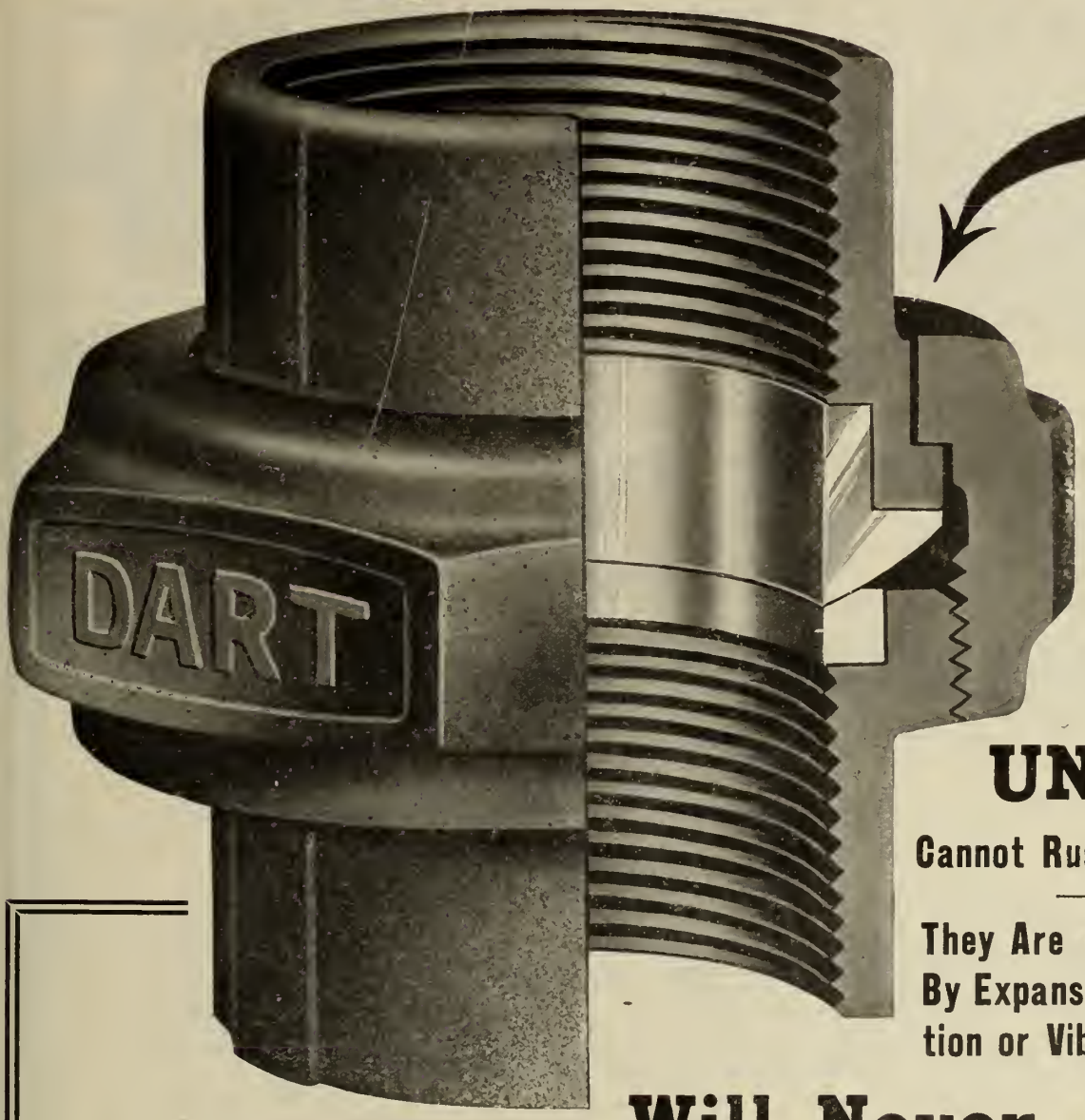
Send for your copy to-day.

Jenkins Bros., Limited

103 ST. REMI STREET

MONTREAL

Bronze to Bronze



AT THE JOINT

DART

UNIONS

Cannot Rust or Corrode

They Are Not Affected By Expansion, Contraction or Vibration, and

Will Never Leak

You can connect and disconnect the Dart Union as often as you desire—you cannot make the "Dart" leak unless you abuse or deliberately loosen it with a wrench.

Ideal conditions with pipe connections exist where Dart Unions are used. With them you can connect pipes easily and quickly whether they are in or out of line. You save the bother and expense of repairs or replacement and you are assured that the joints will always be tight.

Our trade mark DART cast on every union is your guarantee and protection. If any Union bearing this mark is found defective in any way, it will be replaced two for one.

Your dealer has them in all convenient types. Ask him.

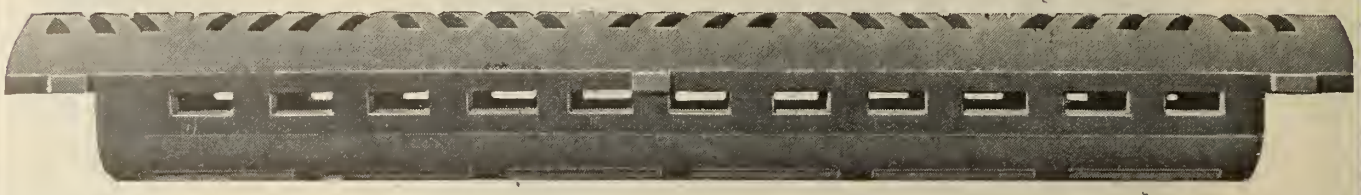
DART UNION CO., Limited

93-97 Niagara Street, **TORONTO, ONT.**

The advertiser would like to know where you saw his advertisement—tell him.

Your Steam Supply LOW and Coal Bills HIGH?

THOMAS ELLIPTIC GRATE BARS



INCREASE Steam Supply, DECREASE Coal Bills.

Cost Less by Lasting Longer. Make more Steam by Increasing Combustion.
Save Fuel by Better Burning the Gases. Save Labor by Reducing Fuel and Cleaning.

KILBY FROG & SWITCH CO.

Birmingham, Ala., August 12th, 1912.

Thomas Grate Bar Co., Birmingham, Ala.

Gentlemen: We have been using the "Elliptic Grate Bars" continuously for the past year, and they are giving us the best of satisfaction. We have not had occasion to renew these bars since we first installed them, and find, after careful watching, they are far superior to the old style bars, not even shown any signs of deterioration since installation.

We heartily recommend them unreservedly to any firm or corporation wanting high grade bars, as they reduce the cost of coal to a minimum.

Yours truly,
KILBY FROG & SWITCH CO.,
(Signed) C. H. Krauss, Superintendent.

WOODWARD LUMBER COMPANY,

Augusta, Ga., August 16th, 1912.

Hickman, Williams & Co., Birmingham, Ala.

Gentlemen: Answering your letter of the 15th, in regard to Thomas Grate Bars, beg to say that we could not give you, with any degree of certainty, the percentage of fuel saved over the old grate bars, as we have never given this matter a practical test. We burn shavings in two of our boilers and R.M. coal in the third; in both instances the bars are very satisfactory, as a matter of lasting qualities, they are beyond anything we have ever used. This particular feature led us to make our first purchase of Thomas Grate Bars, and we find that they will last two or three times as long as any other grate bar we have ever used, thus saving a great deal in renewal.

Yours very truly,
WOODWARD LUMBER CO.
(Signed) J. C. LEE, President.

Solving others' STEAM troubles, WHY NOT YOURS?

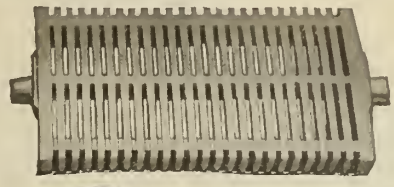
Write to-day for STEAM TROUBLES FOLDER

The General Supply Co. of Canada Ltd.

OTTAWA, TORONTO, WINNIPEG.

Thomas Grate Bar Co., Birmingham, Ala., U.S.A.

Imitated In Construction But Unequalled In Quality Or Efficiency



Saves Fuel and Labor

"THE Cyclone"

Shaking and Dumping Grate Bar

Are you trying to solve that perfect combustion problem? if so, we can show you the shortest way out of your troubles.

The "Cyclone" has proved that it generates more steam from less fuel than any other.

Its construction allows 68 per cent. air space and 90 per cent. Under Draft.

The improved shaking mechanism means more vigorous and effective shaking and prevents any ashes or clinkers from clinging to the centre of the grate.

The use of the "Cyclone" permits the use of the cheapest grades of fuel with results equal to that of the best.

Let us connect you with some users—get their verdict.

You cannot afford to overlook this great money saver.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST :-: :-: :-: **TORONTO, CANADA**

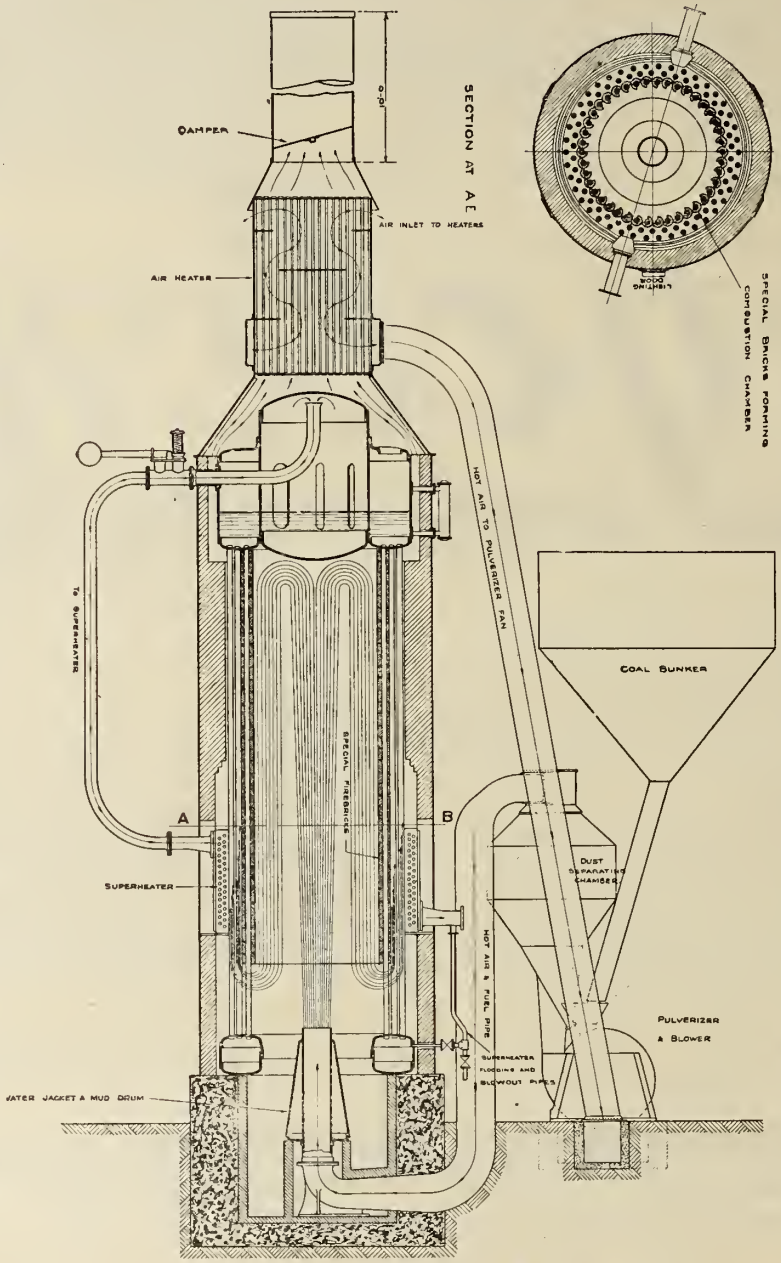
AGENTS

ST. JOHN, N. B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.

Are You Satisified With the Evaporation from Your Boiler Plant?

Send us an Analysis of your fuel and we will tell you what the **BETTINGTON SYSTEM** will save in increased efficiency.

5000 H.P. NOW ON ORDER FOR CANADIAN CUSTOMERS.



SECTION OF BETTINGTON BOILER

This method of raising steam from cheap low grade, high ash, coal has been thoroughly developed by us and has been in commercial use for over 6 years.

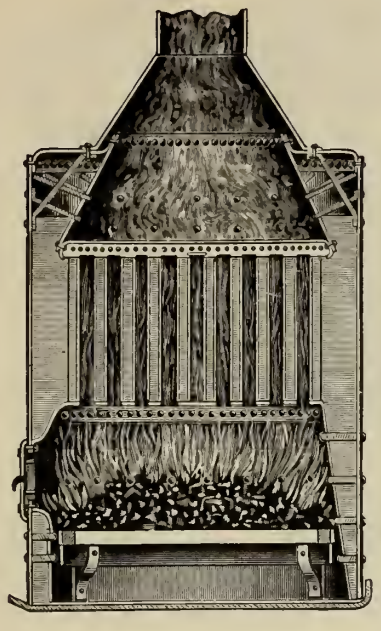
ADOPTED BY THE BRITISH ADMIRALITY.

FRASER & CHALMERS, LIMITED

Canadian Office:

4 PHILLIPS PLACE, - - - - MONTREAL, P. Q.

The advertiser would like to know where you saw his advertisement—tell him.



Marine Boilers

We build various types: Scotch, Clyde, Fitzgibbon, Vertical, Mosher.

Land Boilers

Horizontal, Tubular, Vertical, Locomotive Type, Water Tube, "Heine."

GENERAL PLATE WORK

THE BEST MATERIAL, MANIPULATED BY EXPERIENCED WORKMEN, ENSURES A FIRST CLASS BOILER.

We Employ Both. ***Consult Us.***

POLSON IRON WORKS, LIMITED

STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

TORONTO **CANADA**

REPRESENTATIVES IN CANADA FOR

The B. F. Sturtevant Co., Hyde Park, Mass., U.S.A., Fans, Blowers, Heating and Ventilating

The John I. Thornycroft Co., London, England, Marine Motors

SAVE 50%

By Using
GREASE AS A LUBRICANT
In The

"PHILADELPHIA" GREASE CUP

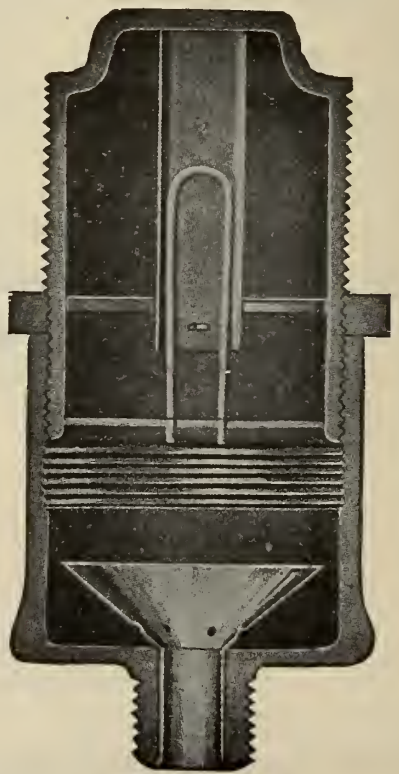
Automatic Feed Under Compressed Air
Slow And Continuous
No Oil Drips—Reduced Fire Hazard

Unexcelled for Lubricating Loose Pulleys, Crank Pins and all classes of Extremely High Speed and Heavy Running Machinery.

In the "Philadelphia" Grease Cup System of lubricating there is no friction, no piston or spring is used, just a thin metal disc resting lightly on the grease to keep it level.

Air pressure above and the needs of the journal below are all that is required to give perfect lubrication. Grease does not change in the slightest, while in the "**Philadelphia" Cup**; the last drop is as good as the first.

There is a large unrestricted outlet and a regularity of action which permits feeding of grease of any thickness.

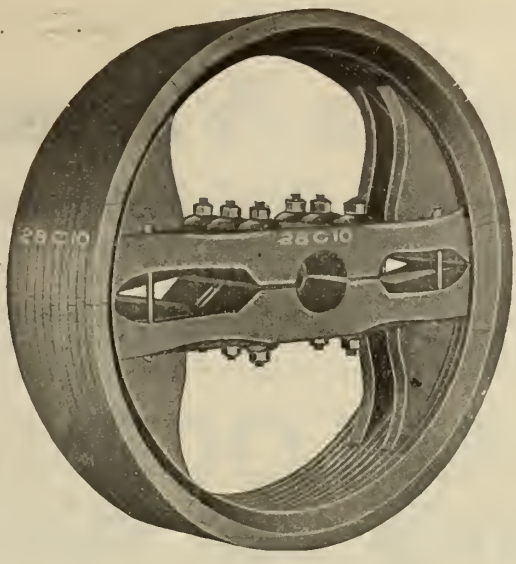


We guarantee a saving of at least 50% over any other system. You must be perfectly satisfied before you pay a cent.

Our Booklet tells more about it — write to-day.

Peterborough Lubricator Mfg. Co., Limited

PETERBOROUGH, ONTARIO



For Power Transmission

Use Fairbanks

Wood Split Pulleys

These Pulleys are the result of years of experience in the manufacture of Wood Pulleys. They embody many excellent features and are conceded to be in every mechanical detail, the most perfect Wood Pulley made.

The arms are made of birch in varying numbers of sections according to the width of the pulley, and are clamped to the shaft by through bolts.

A special feature of construction which makes these pulleys the peer of all others and overcomes the inherent objection to Wood Pulleys, i.e., the separating of the rim from the arms, is the web. This web is mortised into the arms and rim, securely holding the whole pulley together.

The Rims and also the Webs are made of thoroughly seasoned bass wood, as it will transmit 25 to 60 per cent. more power than any other. The Rim is built up in segments or "lags" about 6 inches long. Every layer breaks joints with the preceding layer and each segment is nailed to the others by triple coated nails. These nails are triple coated to prevent them from pulling out and as a protection against dampness, oil, etc.

Each pulley is covered with several coats of special water-proof varnish, which forms an excellent surface for the belt.

These pulleys are bored to a standard and have a complete system of interchangeable Wood Bushings, one set of bushings furnished with each pulley.

ASK FOR CATALOG No. 17

The CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

SCALES, VALVES, GAS ENGINES, PUMPS, RAILWAY AND CONTRACTORS' SUPPLIES, ETC.

Montreal, St. John, Ottawa, Toronto, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

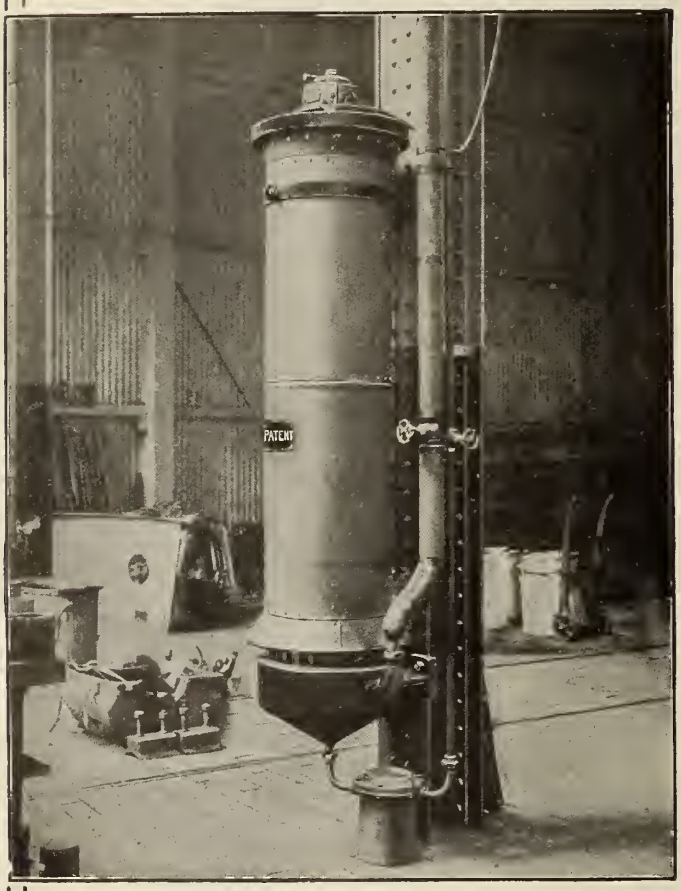
Ventilating a Valuable Fact

A Subject of Vital Importance to Your Business

It is a well established fact that a man working in a properly heated and ventilated shop can accomplish far more than the same man working in a poorly heated and ventilated shop. He can do more, and do it better, and stands a bigger chance of doing it day in and day out.

THE STANLOCK SYSTEM of Heating and Ventilating

Inexpensive at the start and completely satisfactory in use. Adopted by many leading engineers and big manufacturers in this country and Europe.



The System

This system consists of units as shown below. They are made of steel tubes screwed into circular cast iron bases and through these tubes steam passes. Enclosing these tubes is a sheet metal cylindrical casting with a motor at the top. The air is forced downwards, thus keeping the floor warm. A special pipe can be fitted, passing through the roof or through the side wall, thus giving a supply of fresh air. Dampers are provided so that the inside air can be circulated or outside air can be taken in and heated. Can be installed in old or new buildings.

Its Advantages

1. No overhead air ducts are required.
2. No underground masonry ducts are required.
3. No obstruction to light due to overhead air ducts.
4. No heat losses due to radiation from air ducts.
5. Minimum of power absorbed.
6. Units hung on walls. No floor space needed.
7. Various units operated independently and can be turned on or off like radiators. Some supply fresh heated air and others merely circulate and heat.
8. A unit using 60 lb. steam pressure heats 3,600 sq. ft. of floor space.
9. The first cost of apparatus is very low.
10. Units may be added at any time in case of extensions, and in case of boiler shops, units may be removed entirely during the summer months, if desirable.

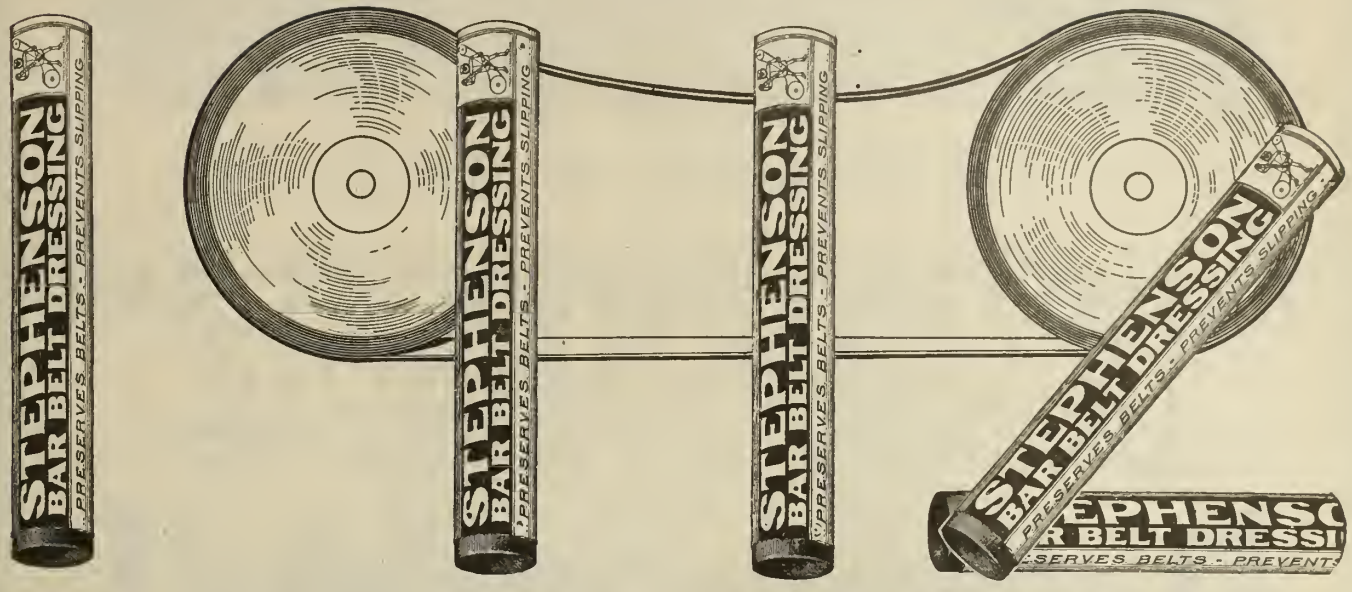
IT WILL PAY YOU TO ASK US FOR COMPLETE INFORMATION AND AN ESTIMATE ON YOUR REQUIREMENTS. DICTATE A LETTER TO-DAY

THE GARTH COMPANY

Sole Canadian Agents

26-32 Craig Street, Montreal

For



Use Stephenson Bar Belt Dressing

Make 1912 a record breaking year. Turn over a new leaf and get rid of the things that have been causing needless trouble and expense. Adopt the things which will make your work easier, give better results and save money for your employer. You cannot start at a better place than with your belt dressing.

Get rid of your troublesome liquid dressing. Shake the can for the Stephenson solid stick and shake trouble at the same time.

Stephenson Bar Belt Dressing is a friend in need. It doesn't require preparation, nor do you have to use special care in applying it. The minute the belt slips you hold the Stephenson bar to the belt for a few seconds and the slipping stops. There's no waste—no slop—no smearing on of paste or pouring on of spattering liquid. And the results are better.

I'll "Stick to the Solid Stick"

Start With a Free ½ Lb. Sample

Simply send us your name and address and we'll send you a present in the shape of a free half-pound sample of Stephenson Bar Belt Dressing.

Remember—we give you this sample absolutely free of charge. Get this free half-pound of the finest belt dressing made and test it. Here's your chance to try somesomething really good at no expense.

None Genuine Without Trade-Mark

Stephenson Manufacturing Company

Est. 1888 **Albany, N.Y.** Inc. 1897

The advertiser would like to know where you saw his advertisement—tell him.

Eight Reasons Why

You Should Make
A Practice of Using

(1) Eclipse is perfectly harmless to boilers and their fittings.
(2) Eclipse keeps boilers entirely free from scale by depositing the scale forming particles as mud.
(3) Eclipse forms a filmy enamel upon the heating surfaces, which is a sure protection against pitting and corrosion.
(4) Eclipse neutralizes the effect of oil and grease; it also prevents priming.
(5) Eclipse softens and removes old scale.
(6) Eclipse is cheap to use, because only a very small quantity is required.
(7) Eclipse acts in the same way in all waters, because its action is mechanical.
(8) Saves an enormous amount of fuel.

W. W. CARRUTHERS

450 Edmonton Street, WINNIPEG, MAN.

Sales Agents for Ontario—M. McEACHERN, 131 Montrose Ave., TORONTO

The advertiser would like to know where you saw his advertisement—tell him.

TRADE MARK

EVERYWHERE

TRADE MARK

If you were in some far off land and needed babbitt metal would it not be a comfort to you, if not actual pleasure, to find "good old reliable Magnolia Metal"?

What a history could be written of its wanderings over the seven seas by ships, up the Andes on Llamas, to the mines in Mexico by Burros, to the teak forests of Siam on Elephants; trekking over the sands of Africa by Ox Carts, or across the steppes of Siberia on sleds.

Engineers and Mechanics cannot take chances in these out of the way places with their babbitts; they must have the best, and therefore specify Magnolia.

They know that Magnolia is always uniform and reliable, that it is suitable for highest speeds or heaviest pressures, and can also be used for piston packing, bull rings, etc., etc.

Tamsos Mine, Tarkwa,
Via Sekondi, West Africa.
June 7th, 1911.

Magnolia Metal Company,
New York City.

Dear Sirs:—

As a user of "Magnolia Metal" for some years—in all parts of the world—and under some rotten conditions, I have pleasure in forwarding 50 cts. for one of your Engineer's Pocket Books, knowing full well that anything coming from the home of Magnolia Metal will be good.

I am at present using Magnolia Metal throughout this plant. We get it through our London Purchasing Agent and it is dandy stuff too.

Wishing you every success with your good goods, permit me to remain,

Yours very truly,

K. R. MOURE, Chief Engineer.

SPECIAL OFFER.

PRACTICAL ENGINEER POCKET BOOK: 700 pages, over 2000 subjects. Price 40c. post paid. We do not aim to make a profit on these books. We import these books, in large numbers, from England, as an advertising medium and give Engineers the benefit of low price. They are highly spoken of.

Address Montreal Office.

Sold by leading Dealers everywhere or by

Magnolia Metal Co.

OFFICE AND FACTORY:

225 St. Ambroise St. MONTREAL

The Big Question of the Hour

How to Convert Waste Into Profits

That's the big question that is commanding attention in every great industrial plant to-day!

As competition grows keener, it becomes more evident that the profits of to-morrow will be taken out of the wastes of to-day!

DEARBORN TREATMENT PREVENTS WASTE IN THE BOILER ROOM

By preventing scale formation, corrosion, pitting, foaming, and all feed water troubles, it gives greatly increased steaming efficiency without increase of boiler capacity—effects large reductions in fuel expense—cuts down boiler repair cost, and prolongs the life of your investment in your boilers.

These big economies warrant your investigation of Dearborn methods of water treatment. Send gallon Sample of your boiler feed supply for analysis, and we'll advise with you regarding special treatment to correct the troublesome conditions at your plant.

Dearborn Drug & Chemical Works

General Offices, Laboratories and Works, Chicago

Would you like to Spend your Sundays at Home?

Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

YOU can reduce the labor and expense of boiler cleaning and cut down your consumption of fuel by using

McCOLL'S Special Boiler Compounds

or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

WRITE FOR PARTICULARS TO

McCOLL BROS. & COMPANY

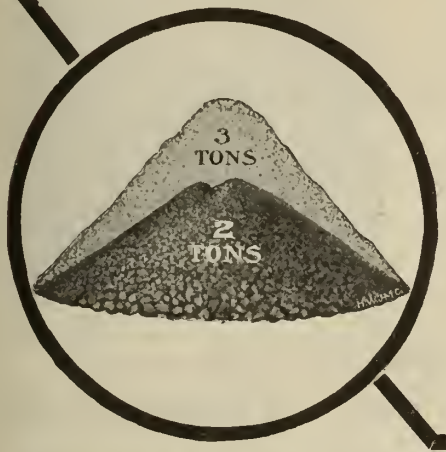
Montreal, Toronto, Winnipeg or Vancouver

The advertiser would like to know where you saw his advertisement—tell him.

It Acts on the Scale Itself

J-M Boiler Preservative gets right at the seat of boiler scale troubles. It doesn't depend upon any water analyses, but acts on the scale itself—removes it and prevents its formation. Its principle of action is direct—devoid of any roundabout water-softening methods. When the iron is hot, it attracts J-M Preservative like a magnet does steel. The preservative works through the cracks and along the metal under the scale, loosening the scale and causing it to drop off. It puts a film coating on the steel, which is an absolute conductor of heat, thus protecting the steel against corrosion and pitting, and preventing further formation of scale.

J-M Boiler Preservative



effects a saving in fuel that is impossible with the more indirect methods. A mere ⅛ inch of scale wastes a third of your fuel consumption—and not only that, it also wastes a third of the fireman's energy. In other words, two boilers kept clean by J-M Boiler Preservative will do the work of three which are coated by ⅛ inch of scale. On every 100 tons of coal, at $3.00 per ton, you can therefore save $100 by doing away with the scale.

Write our Nearest Branch for Booklet and Further Particulars.

The CANADIAN H. W. JOHNS-MANVILLE CO., Limited

Manufacturers of Asbestos and Magnesia Products

ASBESTOS

Asbestos Roofings, Packings, Electrical Supplies, Etc.

TORONTO MONTREAL WINNIPEG VANCOUVER

1637

"SIMS" TUBULAR FEED WATER HEATERS

Are Necessities To Every Boiler Room

FUEL and BOILER SAVERS

The "SIMS" Heater is made of the best material, by the latest tools, skilled workmen and scientific methods. All parts are thoroughly standardized by gauges and templates, and are subject to rigid inspection before leaving our works.

The "SIMS" is noted for its simplicity, its durability, and its splendid service-giving qualities.

It will pay you to investigate the "SIMS." It has made good friends wherever used. **Let us send you letters which we have received from users.** These letters will convince you that it will be a **profitable investment.**

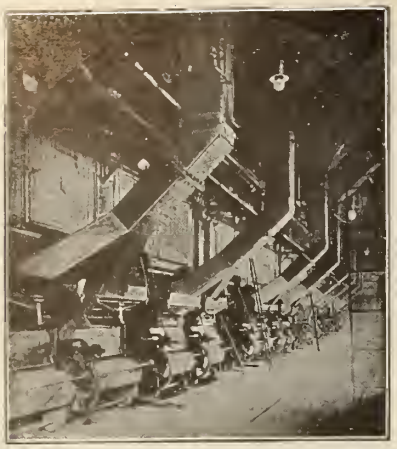
Write for descriptive Catalogue

THE SIMS COMPANY, - - Erie, Pa.

CANADIAN REPRESENTATIVES:

H. L. Peiler & Co:, 380 St. James Street, Montreal, Que., and 69 Adelaide Street West, Toronto, Ont.

The advertiser would like to know where you saw his advertisement—tell him.



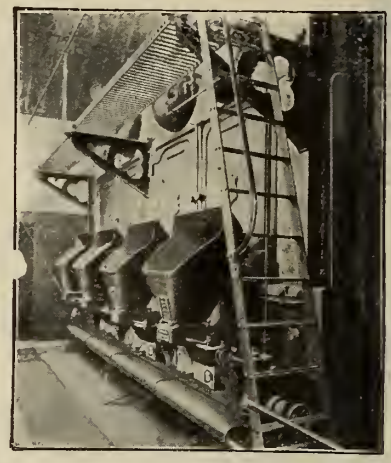
"Bennis" New Link Chain Grate Stokers.

Bennis Chain Grate Stokers
Bennis Coking Stokers

and Patent Self-Cleaning Compressed Air Furnaces for Water Tube and Horizontal Return Tubular Boilers.

Bennis Machines are supplying over 3½ Million Horse Power and are saving Millions of Dollars a Year.

"BENNIS" machines feed the fuel where the fire requires it, keep the fire at a nicely calculated distance from the boiler front, and respond to varying loads with a rapidity that is the outcome of good design. They ensure the maximum results from the boilers, reduce the fuel bill, and keep clean chimneys because they ensure good combustion.



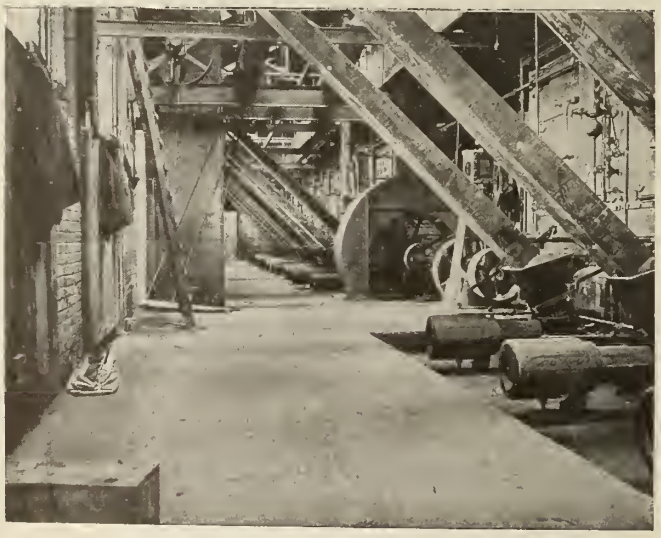
For Cheap Steam without Smoke from water-tube boilers install "Bennis' Machine Stokers.

"Bennis" stokers are not simply made from one design and adapted to meet the requirements of different types of boilers, but are specially designed for the various types, constructed with the greatest care and fitted to meet individual conditions.

The greatest economy is achieved when Bennis elevating and conveying plant feeds the stokers. "Bennis" coal and ash-handling plant has acknowledged advantages over other types, not only in design and construction, but in the small amount of power required to operate it effectually.

Write for "Boiler-House Economy" pamphlets and full particulars to

GEO. H. TOD, 213 Manning Chambers, Queen St. West, TORONTO



DOMINION SUGAR CO., Ltd., BERLIN, ONT.

ALL CONTRACTS SUBJECT TO STRIKES, ACCIDENTS, OR OTHER CAUSES BEYOND OUR CONTROL

DOMINION SUGAR COMPANY, LIMITED.

WALLACEBURG, ONT. May 30th, 1912

ADDRESS ALL COMMUNICATIONS TO THE COMPANY

Messrs. Jones Underfeed Stoker Co., Limited,
TORONTO, Ont.

Gentlemen,-

We are pleased to advise you that the installation of the fourteen Stokers which we put in our Berlin plant last year, has given the most perfect satisfaction. We operated our Refinery at that plant for about 65 days, and saved slightly over half the total cost of the installation.

We are also placing an order with you, to equip the balance of our boilers at that plant, to be ready for our fall run.

Yours truly,
DOMINION SUGAR CO., Ltd.

DAG/M

General Manager

In 1910 the above Company operated their boiler plant *hand fired!*

In 1911 they had 14 Jones Underfeed Stokers to do the firing!

NOW they have 20 Jones Underfeed Stokers looking after their interests!

Their letter herewith states their *saving*—their *satisfaction*. The *saving* is all *their* own! Their satisfaction is *our* success!

JONES UNDERFEED STOKER COMPANY
LIMITED

NATIONAL TRUST BLDG. TORONTO

The advertiser would like to know where you saw his advertisement—tell him.

THE VULCAN IMPS

I SAVE LABOR
SO DO I
I CLEAN TUBES EVERY FEW HOURS
I CLEAN TUBES 100%
I INCREASE BOILER CAPACITY
I LIKE TO PLAY WITH ANY COMPETITOR
I BLOW WITH THE DRAFT
I SAVE HOSE

"And We All Save Coal"

Wherever the **VULCAN SOOT CLEANER IMPS** are allowed to work they raise the Devil—the Soot Devil. They juggle the heat units and make two units grow where one unit grew before. They make slow steaming boilers "pop" for the first time in years. They give many a weary engineer and fireman a chance to rest. The IMPS are always on the job, "they work while you sleep." They cut out lost time, trouble and repairs. They are good for the operating man and mighty good for the boiler owner. Don't let Soot, the expense maker, worry you longer. Fill out the coupon, mail it now, and we'll send you our Free Booklet, "Economical Steam Production," which shows how the Vulcan removes Soot, and saves from 5 to 15% in fuel.

Mail the Coupon

Vulcan Tube Cleaning Systems,
LIMITED

42 Craig St. West **MONTREAL**

SIGN, TEAR OUT AND MAIL

P.H. 10-12. Date.....

VULCAN TUBE CLEANING SYSTEMS, LIMITED, Montreal.

Please send me, without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.

(It is important that following information be given in full.)

WATER TUBE BOILERS. Number.....Type.....
Pressure .....Horsepower .....No. Tubes H
(except on Stirling boiler .....Any Superheaters .....Width of alley space at side .....
TUBULAR BOILERS. Number.....Horizontal or Vertical .....
Name .....
Address .....

THE MURPHY AUTOMATIC SMOKELESS FURNACE

In last month's issue of "Power House" we listed nine **well-known Canadian firms** using **MURPHY AUTOMATIC SMOKELESS FURNACES**; nine years' experience and down to one year, showing **13 repeat orders.**

In Toronto we have in process of installation:

5 Furnaces *Toronto University* .....2000 H.P.
(This is a Central Light, Heat and Power plant.)
4 Furnaces *Toronto General Hospital* .....1644 H.P.
3 Furnaces *Toronto Carpet Mfg. Co.* ..... 425 H.P.
(This is a second contract.)
3 Furnaces *C. P. R. Office Bldg.* ..... 450 H.P.

The Fall of 1907 we installed 3 furnaces with water-tube boilers—each 250 H.P.—in the plant of the **Canadian Locomotive Works, Ltd.**, Kingston, Ont. Oct. 1910, 1 furnace, with like boiler unit as above. We now have in process of construction **two additional furnaces**—to be installed with boilers 333 H.P. each.

"THERE MUST BE A REASON!"

For printed matter address

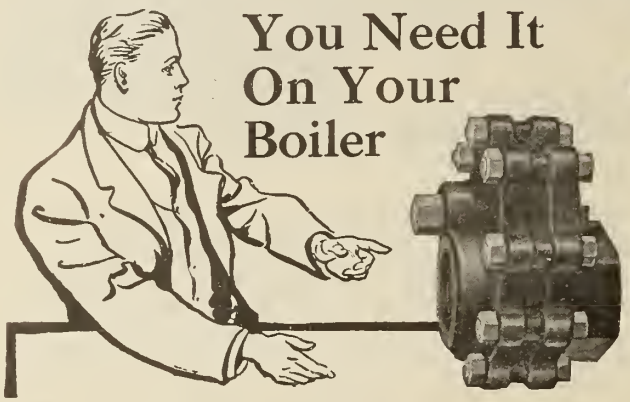
MURPHY IRON WORKS, DETROIT, MICH. BUFFALO, N. Y.

A GOOD INVESTMENT

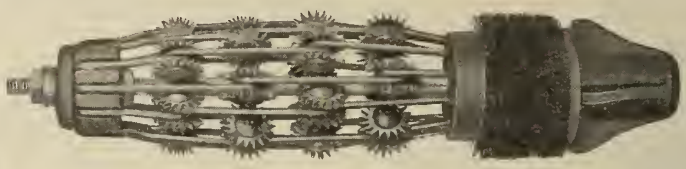
IS MONEY SPENT IN KEEPING THE BOILERS CLEAN

HERE ARE TWO OF THE BEST MEDIUMS

"EVERLASTING" BLOW-OFF VALVE—THE "FLEXIBLE" TUBE CLEANER



You Need It On Your Boiler



The "FLEXIBLE" Tube Cleaner does a better job with half the labor. It rolls through the tube. Sent on trial if desired.

Engineering Specialties Company

1080 King Street West — **TORONTO, ONTARIO**

AGENTS:

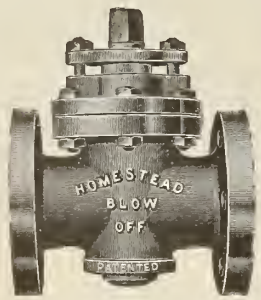
H. L. PEILER & CO., 380 St. James Street, Montreal

THE A. R. WILLIAMS MACH. CO. OF ST. JOHN, N.B., LTD., St. John, N.B.

P. D. McLAREN, LIMITED, Calgary, Alta.

HOMESTEAD
STRAIGHTWAY VALVES

ALWAYS OUTLAST OTHER VALVES



For Pressure Up to 5000 lbs. per. Sq. In.

The reason is very evident.

Where the common Globe and Gate Valves have their vital parts—the seats—exposed to pressure and constant wear, every minute they are open, the seat of the Homestead Straightway is never exposed.

The plug is balanced and held in place by the pressure when open, and when closed it is locked in the seat by our patent wedging cam, insuring freedom from friction in the seat while the plug is turning and making the Homestead the quickest acting, the simplest, the most easily operated and the most durable valve known.

Let us send full details. Write

Homestead Valve Mfg. Co.

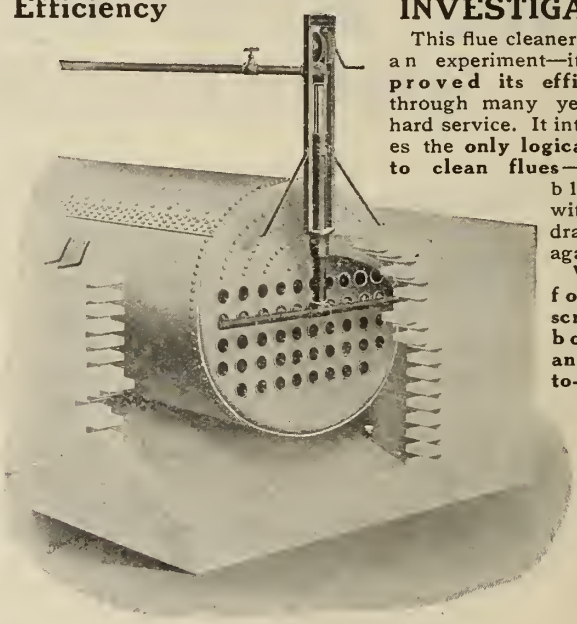
PITTSBURG, PA.

'THE HENRY' STEAM FLUE CLEANER

Saves Fuel, Saves Labor, Increases Boiler Efficiency

INVESTIGATE

This flue cleaner is not an experiment—it **has proved its efficiency** through many years of hard service. It introduces the **only logical way to clean flues**—steam blows with the draft--not against it. **Write for descriptive booklet and price to-day.**



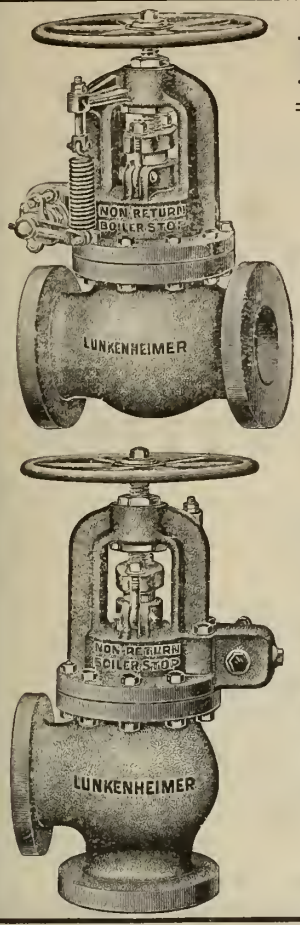
Let us send one for your approval

THE STEAM APPLIANCE CO.

MILWAUKEE, WISCONSIN.

Western Agent: **CANADA SALES CO.** Donalda Bldg. Winnipeg.

Eastern Agent: **ENGINEERS REPRESENTATIVE CO.** 201 Board of Trade Bldg. Montreal.



LUNKENHEIMER NON-RETURN SAFETY

BOILER STOP VALVES

In any steam plant where two or more boilers are installed in battery, the outlet from each boiler where same is connected to the header, should be provided with a **Lunkenheimer Non-return Safety Boiler Stop Valve.**

Should the pressure in one of the boilers suddenly decrease, caused by an accident, a **Lunkenheimer Non-return Safety Boiler Stop Valve** is guaranteed to close immediately and prevent the steam from the other boilers of the battery entering and discharging through the disabled one. Danger to life and property is greatly lessened, and as the plant can be operated with the other boiler, or boilers, without interference, considerable time and money are saved. Chattering of the disc, caused by the fluctuation of the steam pressure, is prevented by an ingenious outside spring arrangement.

Lunkenheimer Non-return Safety Boiler Stop Valves are exceptionally strong, durable and reliable. All parts subjected to wear are renewable. Made in five different combinations of material to suit the requirements of various conditions of superheat and high pressure, and to meet the specifications of engineers who may differ as to what is best suited to the purpose.
Your local dealer can furnish them; if not, write us.
Write for 1912 catalogue.

THE LUNKENHEIMER COMPANY

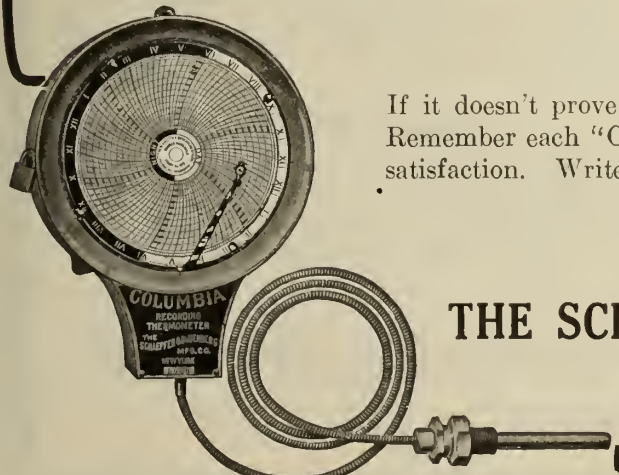
Largest Manufacturers of High-Grade Engineering Specialties in the World.
General Offices and Works: CINCINNATI, OHIO, U. S. A.

NEW YORK,	CHICAGO,	BOSTON,	LONDON, S.E.,
64-68 Fulton St.	186 N. Dearborn St.	138 High St.	35 Great Dover St.

The "Columbia" Recording Thermometer

is mercury actuated, let that sink in. For mercury, you know, is the best substance in existence for measuring temperatures. And to combine strength with accuracy the entire mechanism of the "Columbia" is made of steel, meaning long life. Pen arm is adjustable and recording pens are of glass, non-corrosive and non-spilling. Charts are uniformly graduated, have wide effective working range and the night and day border.

On the strength of these and many other exclusive features, we feel justified in claiming the "Columbia" without an equal. But we don't ask you to believe us. Prove it for yourself—send us your order for a "Columbia."



Give It A Trial

If it doesn't prove satisfactory, send it back—there is no expense to you. Remember each "Columbia" leaves our shop fully guaranteed to give absolute satisfaction. Write for full particulars.

Send for Catalogue W-28 now.

THE SCHAEFFER & BUDENBERG MFG. CO.

Brooklyn, N. Y.

Chicago **Pittsburgh**

(91)

The advertiser would like to know where you saw his advertisement—tell him.

Don't Lose Money

Through long waits for renewal of Broken Machinery Parts

WE CAN

WELD YOUR BREAKS

And make the broken part as strong as the original in a surprisingly short time.

AUTOGENOUS WELDING AND CUTTING

(OXY-ACETYLENE PROCESS)

OUR ONE SPECIALTY

When trouble occurs—telephone or telegraph us. Our Emergency welding repair outfit and operators make speedy trips.
Get in touch with us at once and send us a trial job ---it will pay you.

Our Long Distance Telephone Numbers are

DAY CALLS—Adelaide 198.

NIGHT and SUNDAYS — Hillcrest 431.

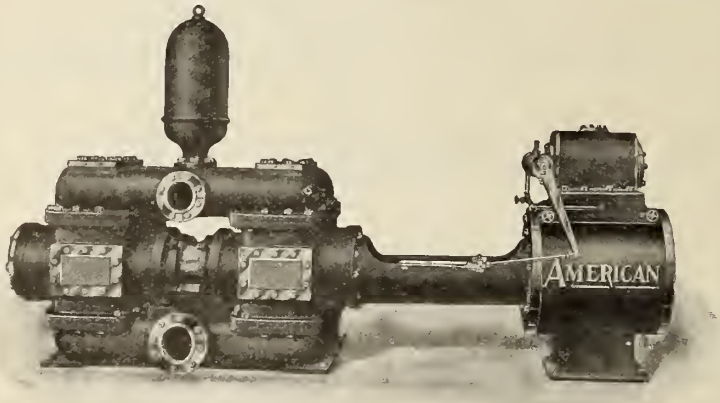
THE FRANCO-CANADIAN WELDING CO.

331 YONGE STREET TORONTO

Get our Name and Address firmly fixed in your mind. You will need us in a hurry some day.

American Steam Pumps

Reputation built on Quality not Cheapness.



A WORD AS TO CONSTRUCTION

Phosphor bronze wearing parts throughout, including water bushings, piston rods, stuffing boxes and valve seats. Heavily constructed water ends built amply strong to withstand any unforeseen strain.

NOTICE THE STEAM END

No slide valves to wear. Steam valve of the balanced piston type. The feature in the American Pump that appeals to engineers is that the steam end wears as long as the water end.

A RECENT INSTALLATION

Twenty-four American Pumps including six compounds were recently installed in the new McAlpin Hotel in New York City, the largest hotel in the world. American Pumps were chosen after careful investigation in competition with numerous other makes.

ASK FOR CATALOG.

CANADIAN AGENTS: A. R. Williams Machinery Co., Toronto; Williams & Wilson, Montreal; London Engine Supplies Co., London; Stuart Machinery Co., Winnipeg; Hallman & Peniston Machinery Co., Vancouver; Gorman, Clancey & Grindley, Ltd., Edmonton and Calgary; Mechanics Supply Co., Quebec.

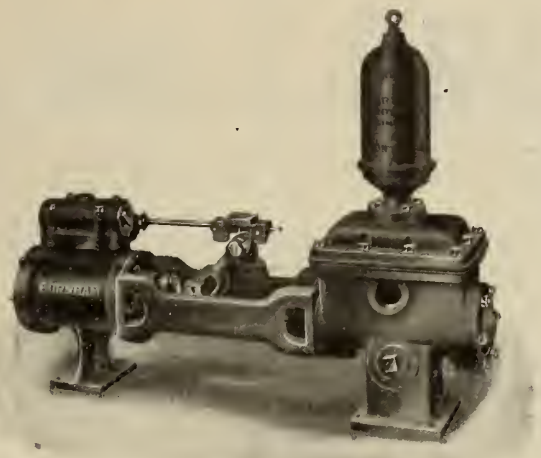
AMERICAN STEAM PUMP COMPANY

Battle Creek, Mich.

BURNHAM STEAM PUMP

Of the thousands of steam pumps installed every year, a large percentage of them bear the name of "Burnham," the **Steam Pump** endorsed by leading Architects, Consulting Engineers and Heating Contractors as the best, simplest and most economical pump on the market.

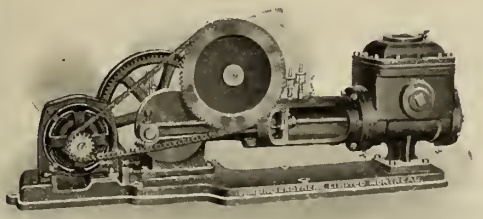
If you want a pump for handling hot water, use the "Burnham."



Burnham Boiler Feed Pump.

Thousands of Burnham pumps are in operation in connection with **Vacuum Heating Systems**; they are specially adapted for this service. Standard Burnham Boiler Feed Pumps and Burnham Vacuum Pumps are kept in stock and can be shipped promptly.

Ask for Catalogue "P."

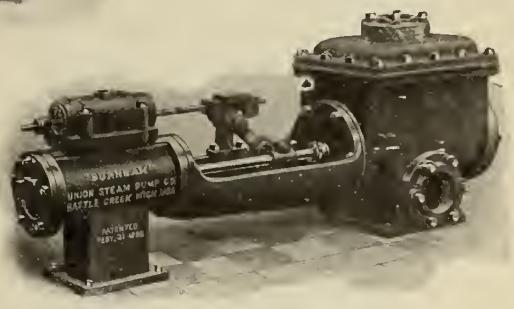


Union Electrically Driven Vacuum Pump.

Darling Brothers,
LIMITED

15 Ottawa St., Montreal.

Toronto, Winnipeg and St. John.



Burnham Vacuum Pump.

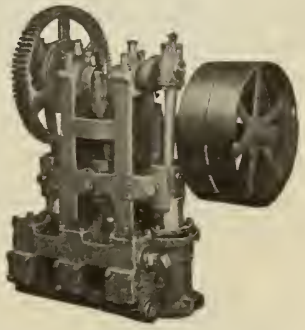
Deming Power Pumps

Made in Many Sizes

For all Pumping Conditions

- Automatic Sprinkler System Pumps.
- Boiler Feed Pumps.
- Combination Water and Air Pumps.
- Deep Well Working Heads.
- Electric Driven Triplex Pumps.
- Gas Engine Driven Pumps.
- Paper Makers' Pumps.
- Railway Water Supply Pumps.
- Tank Pumps for light, medium or heavy service.
- Waterworks Pumps.

and including many others. The entire line is shown in our catalogue "H."



Deming General Service Triplex Power Pump for operation by belt. Requires but little power for operation.

The Deming Company

SALEM - - OHIO, U.S.A.

HAND AND POWER PUMPS OF ALL KINDS

Agencies—Henion & Hubbell, Chicago, Ill.; Darling Bros., Montreal, P.Q., Can.; Morgan Engineering Co., Seattle, Wash.; Root, Neal Co., Buffalo, N.Y.

¶ $35 per Minute---$2100 per Hour!

is a lot of money to pay for one hour of your spare time, but it is being paid—every month.

¶ And the most remarkable part of it is, The Money is Being Paid to Tell You Something You Ought to Know.

¶ America's best manufacturers of the lines of goods you purchase, pay $2,100 every month in order to bring before you in "THE POWER HOUSE" advertising pages, information about their latest and most improved equipment and supplies.

¶ That information should be read by YOU every month. It is invaluable to every buyer, to every Engineer, owner, and superintendent who is anxious to secure that which will give the greatest service.

¶ Be willing to listen to the story that the advertiser has to tell. The purpose of everything new these days is twofold—to save money and to give greater efficiency. Perhaps in this very issue of "THE POWER HOUSE" there is a veritable gold mine for you.

¶ Be open to conviction. Read the ads. Weigh them in your own mind. Say to yourself, will this article save me money? will that new device render my plant more efficient?

¶ If the men who are spending $2,100 this month to advertise in "THE POWER HOUSE" were to meet you personally you would listen to what they had to say. If they were to show you a new device and tell you something interesting about it you would be disposed to examine it, and to examine your own needs to see whether you could profitably use it, wouldn't you? The advertiser is doing it by proxy.

¶ Advertising is the big man's substitute for a personal talk. It is timed for your convenience, for you can read in your leisure. The facts are hard and cold in the printed word. Advertising is paid for by intelligent men for intelligent men to read.

¶ Read the Ads.! Be they large or small they are full of meat. They are written and paid for by firms who are reliable, who are up-to-date, who are liberal, with liberality sticking out of their goods and their service. They are the firms it will pay you to do business with.

¶ Read the ads.

The Power House

R. B. HUESTIS
115 Broadway
New York

143 University Ave.
Toronto

701 E. T. Bank Building
Montreal

One-Sixteenth Of An Inch Of Scale In Your Boilers Will Increase Your Fuel Bills From 15 to 25 Per Cent.

ERADICATE ALL SCALE

by using

WALKER'S ELECTRIC BOILER COMPOUND

Perhaps you are losing money, the same as many other plants are doing, and don't know it.

Wherever scale prevails in the boiler the firm is paying abnormal fuel bills.

Take out insurance against this loss by using our guaranteed **Boiler Compound.**

It will rid your boilers of all scale and prevent pitting, corrosion or other boiler troubles, due to impure feed water, without the slightest injury to tubes or fittings

Send us a sample of feed water for analysis and get our prices.

The Electric Boiler Compound
COMPANY, LIMITED
Guelph, - - Ontario

GRAPHITOL

Pat. and Trade Mark Reg'd.

The graphite cement bearing material.
Another step in the ladder of progress.
A distinct advance over babbitt metals.
The most frictionless material yet produced.
A thorough success.

Write for free illustrated pamphlet describing this material, to

British Pacific Supply Company
F. C. Winkler, Manager,
VICTORIA, B. C.
MAKERS OF GRAPHITOL.

THE
CANADIAN CASUALTY
AND
BOILER INSURANCE COMPANY

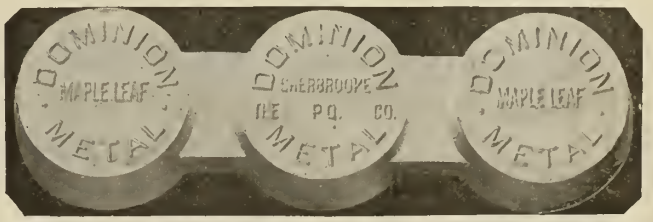
ATTENTION:

In what condition have you left your heating boiler? we would like the privilege to inspect it, and report to you what has to be done before the next heating season.

CONTINENTAL LIFE BUILDING
TORONTO

J. O. B. Latour, Chief Engineer.
John J. Durance, Manager.
Phone Main 6941

From Factory to Consumer



Dominion Babbitt Metals are more generally used where known than any other make in the market.

There is a reason for this—they are sold on merit—every pound fully guaranteed.

We specially commend to users of Babbitt Metal the following Dominion brands of Babbitt as representing the best formulae used in the Engineering World to-day:—

"Genuine" "Special Hard"
"Eagle Genuine" "Metallic Packing"
"Delta Genuine" "Beta Copperized"
"Copper Tough" "Maple Leaf"

Furthermore, these babbitt metals are not only of the most improved design, but **COST THE CONSUMER LESS MONEY** than other widely advertised babbitts. Our Prices are named F.O.B. your Station.

Let us tell you about them, and submit you descriptive catalogue—invaluable to any Engineer.

Have you seen one of our Pipes? One mailed free to any Engineer on request.

The DOMINION METAL COMPANY
N. B. Prichard, Engineer and Manager
SHERBROOKE, P. Q.

The advertiser would like to know where you saw his advertisement—tell him.

J. V. Jamison, President. T. B. South, Vice-President. J. V. Jamison, Jr., Treasurer.

This "Ad" is addressed to users of

Refrigerator Doors, Windows and Ice Chutes

— in Canada —

for Cold Storage, Meat, Fish, Dairy, Poultry, Fruit and Vegetable products.

We guarantee our Doors not to sag or stick in the frames.

Our Hardware weighs 60 lbs. to set.

We manufacture or sell nothing else.

Our entire time and forces are directed to this line.

We supply

Linde British Refrigeration Co.
Linde Canadian Refrigeration Co. of Canada.
Armour & Co., Chicago, Ill., U.S.
Swift & Co., Chicago, Ill., U.S.

with all they use. Our latest orders are to Swift & Co., for Toronto, Can., 30 Doors; Canadian Fish and Cold Storage Co., Prince Rupert, B.C., 110 Doors.

Send for Catalogue

Jones Cold Store Door Co.

HAGERSTOWN, MARYLAND, U.S.A.

6 inch Screwed Iron Body Gate Valve

6 inch Interior View of I. B. B. M. Gate Valve

KERR

IRON BODY

GATE VALVES

The above illustrations are of the new **"KEYSTONE"** pattern gate valve which we are now shipping to our customers, and which is being so favorably commented upon by all who have as yet seen them, owing to their modern equipment and strong compact design.

See that

KERR

is on the body of the next valves you buy.

Specify them, and you'll get them.

The Kerr Engine Co.

LIMITED

WALKERVILLE - - ONTARIO

The advertiser would like to know where you saw his advertisement—tell him.

H-P=PLAN / 33,000

You can compute P from your indicator card, you know L and can figure A, but how do you find N? The surest way, on a high speed or a slow speed engine, is to use a

Starrett Speed Indicator

It registers any speed without heating of parts. Equally good for motors, gas engines, line shafting or any revolving machine-part. Rubber tips for centered or pointed shafts. For sale at all hardware stores.

Get the Starrett Catalog No. 19 C D. It shows other tools for the engineer.

The L. S. Starrett Co.

Athol, Mass.

NEW YORK 150 Chambers Street
CHICAGO 17 No. Jefferson Street
LONDON 36 & 37 Upper Thames Street, E. C.
42-69

"STANDARD" QUALITY

You Pay For Good Wire

whether you use it or not. If you buy a cheap wire, "made to meet a price," you may pay several times the cost of good wire in replacement of your wiring, or of the building in which it is installed.

"Sterling" Rubber Insulated Wire

is made to maintain a standard, not to meet a price. The price, however, is as low as that for which a product of equal quality can be sold.

Our new booklet "Sterling," gives valuable information about rubber covered wire. Sent on request.

Standard Underground Cable Co. of Canada Ltd.

Department B. Hamilton, Ont.

Manufacturers of Electric Wires and Cables of all kinds, all sizes, for all services, also Cable Terminals and Junction Boxes, Etc.

"STANDARD" ECONOMY

D&W REG. U. S. PAT. OFF.

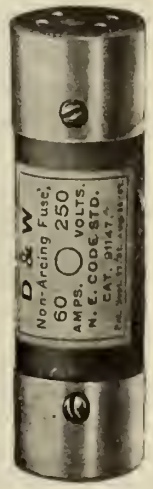
You Are Skating on Thin Ice

D&W REG. U. S. PAT. OFF.

When "protecting" your electrical apparatus with enclosed fuses of inferior quality

Use "D & W" Fuses and Take No Chances

They Are Sure To Be "RIGHT"



Scientifically Made Accurate Strongly Built

THE Northern Electric AND MANUFACTURING CO. LIMITED

Manufacturer and Distributor of Telephone Apparatus Electrical Supplies and Fire Alarm Apparatus for every possible need

Montreal Halifax Toronto Winnipeg Regina Calgary Edmonton Vancouver

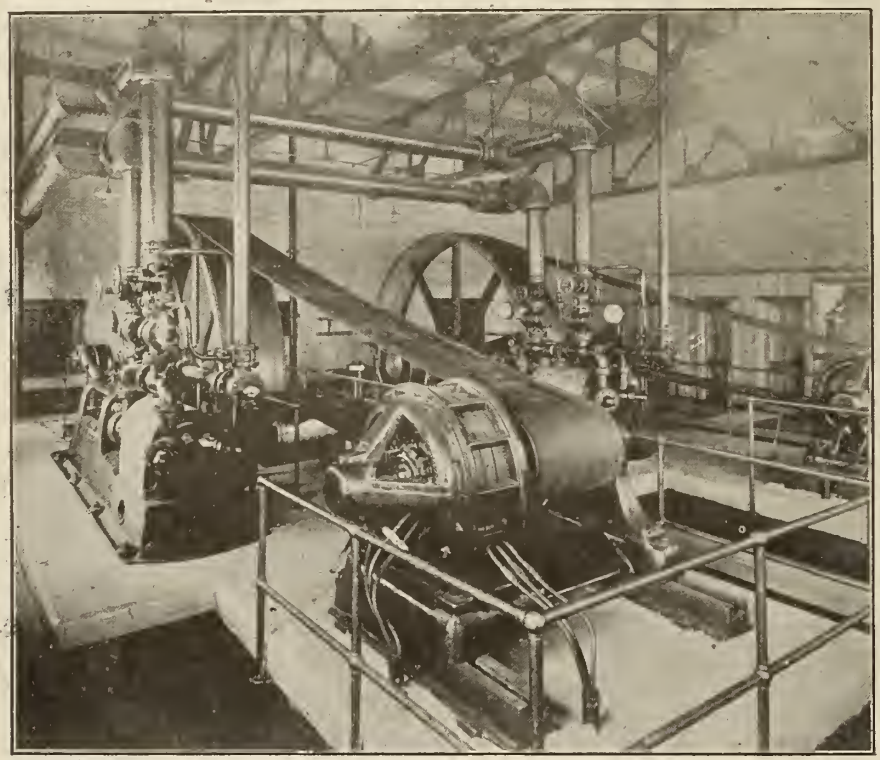
The advertiser would like to know where you saw his advertisement—tell him.

"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton " Linde " Belt Driven, Double Acting, Horizontal Ammonia Compressors Manufactured and Installed by us in Canada.

Recent Orders:—

C.P.R. VANCOUVER HOTEL
Vancouver, B. C.
MATTHEWS, LAING LTD.
Winnipeg, Man.
CARSON'S HYGIENIC DAIRY CO.
Winnipeg, Man.
ST. THOMAS PACKING CO.
St. Thomas, Ont.
MONTREAL GENERAL HOSPITAL
Montreal, P.Q.
OTTAWA UNIVERSITY
Ottawa, Ont.
WM. DAVIES CO.
Winnipeg, Man.
CANADIAN NATIONAL EXHIBITION
Toronto, Ont.
McGILL UNIVERSITY,
Montreal, P.Q.
G. T. P. FORT GARRY HOTEL
Winnipeg, Man.
C.P.R. ALGONQUIN HOTEL
St. Andrews, N. B.

AND MANY OTHERS.

The Linde Canadian Refrigeration Co., Limited

37 ST. PETER STREET, MONTREAL.

BRANCH OFFICES—Toronto, Imperial Building, Adelaide St.; Winnipeg, 909½ Main Street; Vancouver, Anderson & Miskin, Imperial Block, Seymour and Pender Streets; Edmonton, Walker & Barnes, 562 Second Street; Calgary, General Supplies Limited, 1233 2nd Street East.

The advertiser would like to know where you saw his advertisement—tell him.

The LINDE BRITISH Refrigeration Co. Limited

¶ By the most scrupulous care in selection of materials and unrelaxed attention to the minutest detail of design, we have patiently eliminated original weaknesses with the inevitable result that after 35 years of successful, world-wide business competition, our machinery holds an unrivalled and hardly earned reputation for the highest excellence in mechanical detail, and the lowest cost of operation and maintenance hitherto obtained. All the superiority universally associated with engineering products of British manufacture is found in the eight thousand, two hundred odd Ice-making, Air-cooling and General Refrigerating plants installed by us up to date, all over the world.

HEAD OFFICE: LONDON, ENGLAND

LIVERPOOL GLASGOW SIDNEY, N.S.W.
BIRMINGHAM CALCUTTA PORT NAPIER, N.Z.
BRISTOL BOMBAY JOHANNESBURG
S.A.

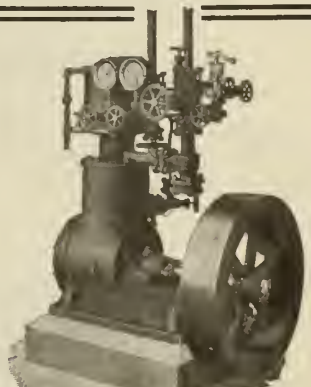
Coristine Bldg.
MONTREAL, P.Q.

ESTABLISHED 1867

THE VILTER MANUFACTURING CO.

242 BECHER ST., MILWAUKEE, WIS., U.S.A.

A small machine for small Ice-making and Refrigerating Plants, as well constructed and as successful in operation as larger outfits. VERTICAL SINGLE ACTING AMMONIA COMPRESSORS, different sizes. Built with fewest possible number of parts. Sold at low price. Excels all others of like size in every point—simplicity, efficiency, reliability, smoothness of action, etc. We build horizontal and vertical ICE-MAKING AND REFRIGERATING MACHINERY, a full line of CORLISS ENGINES, and MACHINERY FOR BREWERS AND BOTTLERS. Our plant covers more than eight acres of ground.



Vertical Single-Acting Ammonia Compressor, Enclosed Type for Belt-drive.

"Angle or Globe"

"AUTOMATIC"

Cushion Non-Return and Triple-Acting Valves

"Work Both Ways"

Largest Steel Co. in the world ordered over 1000 of our valves for the protection of their

"Power Stations"

References

Armour & Co.
U. S. Steel Corp.
Chicago Brass Co.
National Tube Co.
Illinois Steel Co

"AUTOMATIC"

"The Controlling Altitude Valve"

maintain a uniform stage of water in stand-pipes, reservoir or tanks.

No overflow in case of fire pressure. Valves automatically closed by water or electricity.

"Quick Closing Valves"
"Sandpipe Valves"

Automatic Valves
For Steam and Water Service

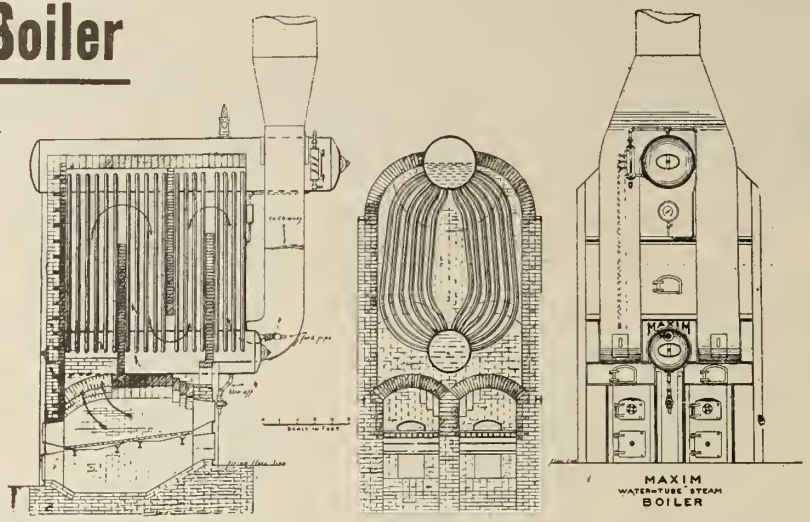
Anderson Reducing Valves for Steam or Water.

GOLDEN-ANDERSON VALVE SPECIALTY COMPANY

1233 Fulton Building
PITTSBURGH, PA.

The advertiser would like to know where you saw his advertisement—tell him.

The Maxim Boiler



Do you understand the purpose of a feed water heater? Well, have you used an economizer? If your boiler carries steam at 100 pounds pressure, the temperature of the steam (and therefore the water in the boiler) is 338 degrees. If you get your waste gases down to 500 degrees you are doing well. This is where an economizer comes in. The waste gases are carried through it and their temperature reduced, maybe by 150 degrees. The feed water is passed through the economizer, going in at maybe 80 degrees and out at 200. THE MAXIM BOILER INCLUDES AS ONE OF ITS PARTS AN ECONOMIZER, and we have cases where the owners report the flue gases reduced to below 300 degrees.

THE ALISON ECONOMIZER IS ARRANGED AS PART OF THE MAXIM BOILER. It is the most effective economizer made. It makes the Maxim Boiler more economical than any other.

Report of test of two 250 H. P. Maxim Water Tube Boilers at works of the Keystone Watch Case Co., Philadelphia:

Average Temp. Feed Water, 62.5 degrees Fahr.

Average Temp. of Steam, 357 degree Fahr.

Average Temp. Escaping Gases, 312 degrees Fahr. Highest, 370 degrees, Lowest, 280 degrees.

Fuel, No. 2 Buckwheat or Rice Anthracite.

Quality of Steam, 99.5 per cent. dry.

EQUIVALENT WATER ACTUALLY EVAPORATED FROM AND AT 212 DEGREES PER POUND OF COMBUSTIBLE, 12.177 LBS.

The above test was made by the owners of the plant.

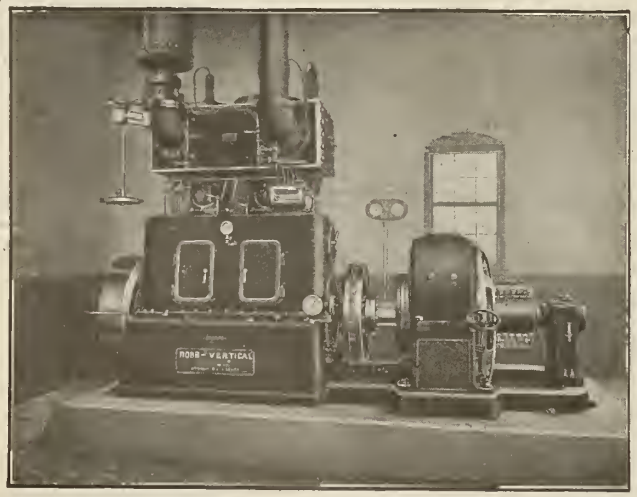
Maxim Tubes do not work loose, and Maxim Boilers make better use of the fuel than is possible with other boilers. MAXIM BOILERS ARE ECONOMICAL ALL THE TIME.

Ogilvy Engineering Company, Bank of Ottawa Building, **Montreal**

COMPLETELY ENCLOSED

For cleanliness and protection of moving parts

ROBB COMPOUND ENGINES



VALVES, perfectly balanced, are placed outside for accessibility.

BEARINGS, supplied with an abundance of oil under pressure of 10 to 20 pounds per square inch, run for months without attention.

INTERCHANGEABLE PARTS kept in stock for immediate shipment.

Speed just right for direct connection to electric generators. Close regulation for electric lighting.

ASK FOR
NEW CATALOG
Describing Robb Vertical Engines

ROBB ENGINEERING COMPANY, Limited

AMHERST, N.S., CANADA.

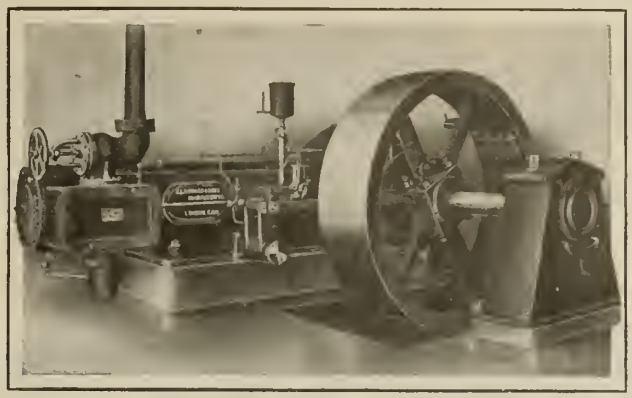
SOLE CANADIAN AGENTS FOR
C. A. PARSONS & COMPANY, Newcastle-on-Tyne.
Turbines, Turbo-Electric Generators, Turbo Pumps, Blowers and Compressors.

SOUTH FRAMINGHAM, MASS.

DISTRICT OFFICES:
Canadian Express Bldg., Montreal, R. W Robb, Manager
Traders Bank Bldg., Toronto, Wm. McKay - "
Union Bank Bldg., Winnipeg, Wm. F. Porter, "
Grain Exchange Bldg., Calgary, J. F. Porter - "

39-17

The advertiser would like to know where you saw his advertisement—tell him.



Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY

E. LEONARD & SONS, LONDON, ONTARIO

MANUFACTURERS OF

High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants.

WAREHOUSES AND AGENCIES AT

MONTREAL, ST. JOHN, N. B., CALGARY, WINNIPEG, VANCOUVER

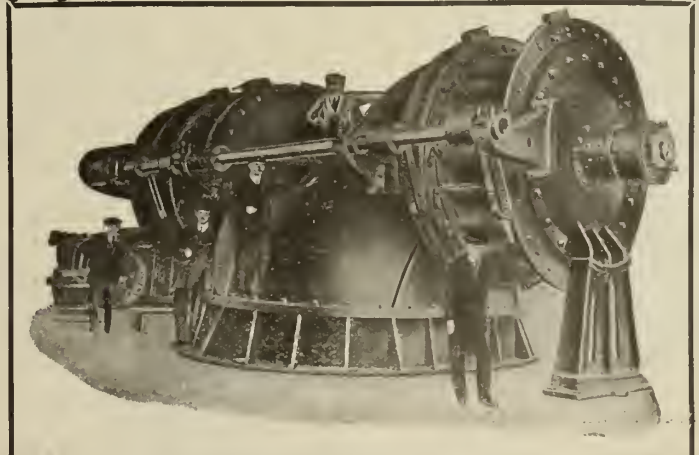
WATER TURBINES

—AND—

GOVERNORS

All Sizes

Maximum Efficiency



All Heads

Ideal Control

ASK FOR PARTICULARS FROM

THE CANADIAN BOVING CO., LTD.

164 BAY STREET, TORONTO.

Branch Office for British Columbia, 427 Seymour St., Vancouver

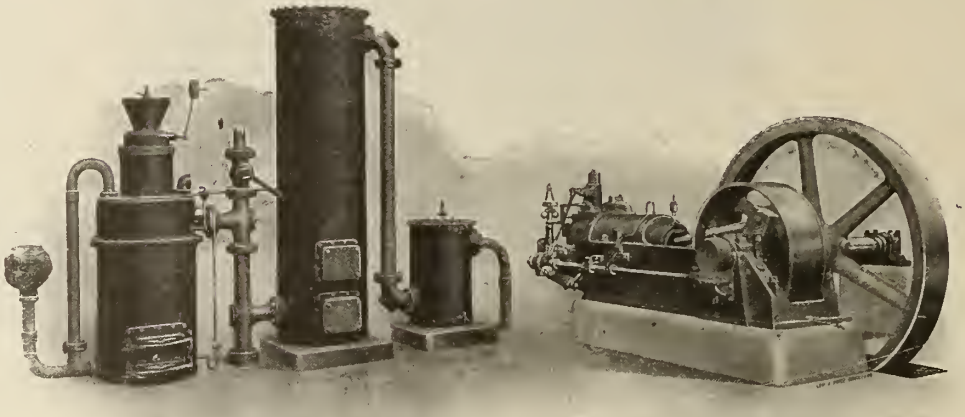
The advertiser would like to know where you saw his advertisement—tell him.

ESTABLISHED 1870.

JOHN ROBSON, (Shipley), Ltd.

SHIPLEY, Yorks, England.

Sole Makers of the **"Robson"** Oil Engine for working on Crude and Petroleum Oils.



Sole Makers of the **"Robson"** Engine for working on Towns and Suction Gas.

Photograph of Gas Engine and Suction Gas Producer Plant.

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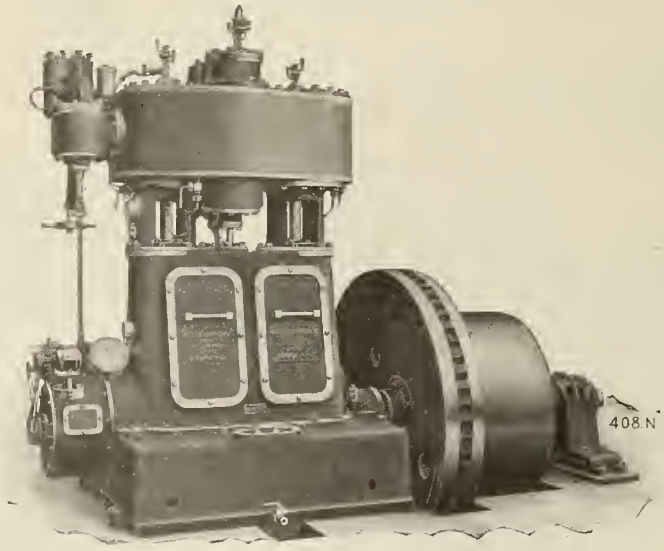

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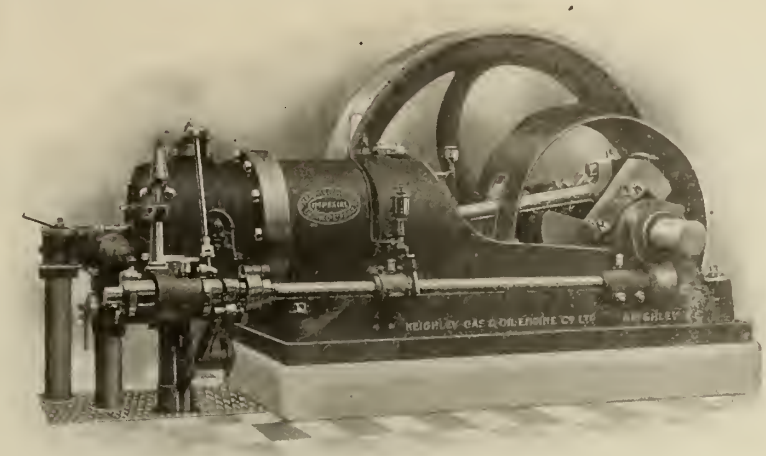

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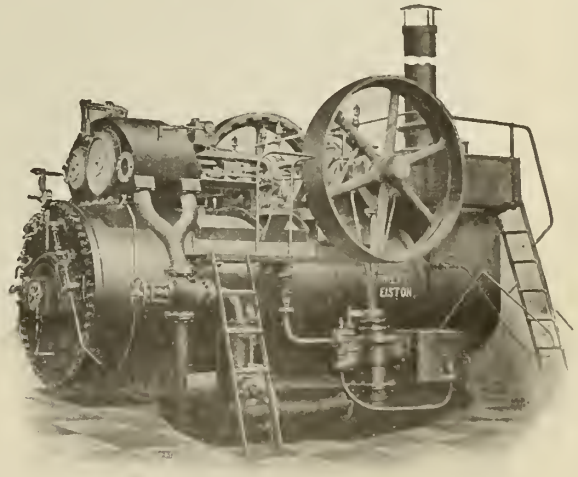

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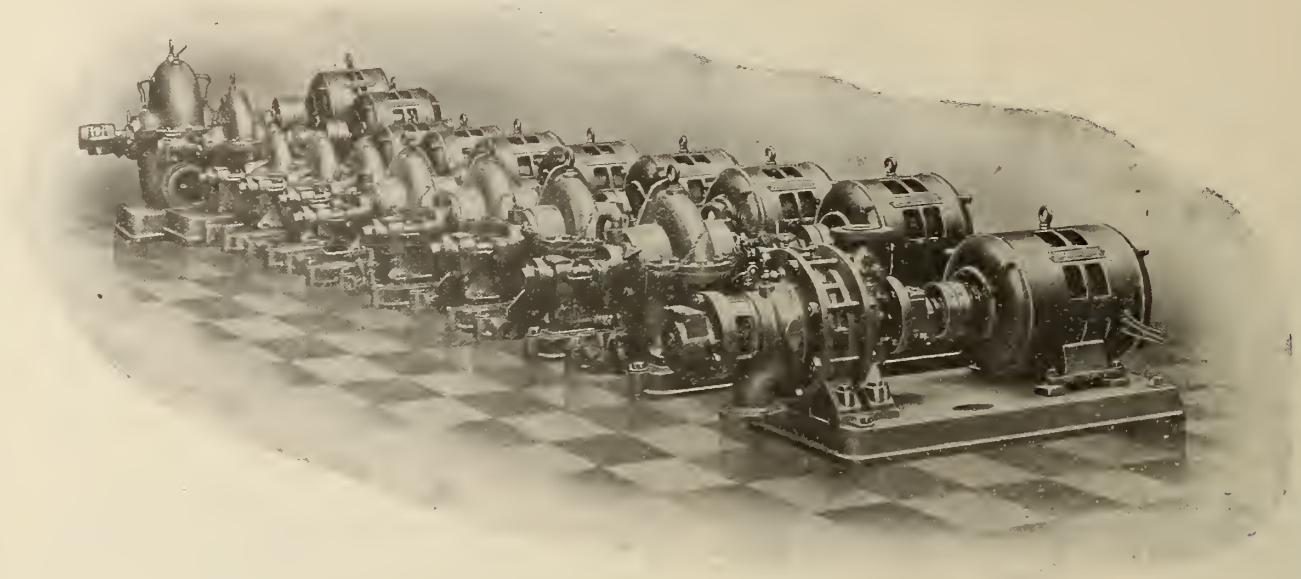

The illustration represents Ten Pumps used as Main Water Pump, Caustic Liquor Pumps, Special Digester Pumps, Boiler Feed Pump, and was supplied to the Dryden Timber and Power Co., of Dryden, Ont.

The majority of these pumps are of special types and specially designed for this class of work, and the whole manufactured by Messrs. W. H. Allen Son & Co., Bedford, England. These are coupled direct to special ball-bearing motors of the star delta and mesh types, manufactured by the Lancashire Dynamo and Motor Co., of Manchester, England.

The horse power of these motors running from 10 to 150 h.p.

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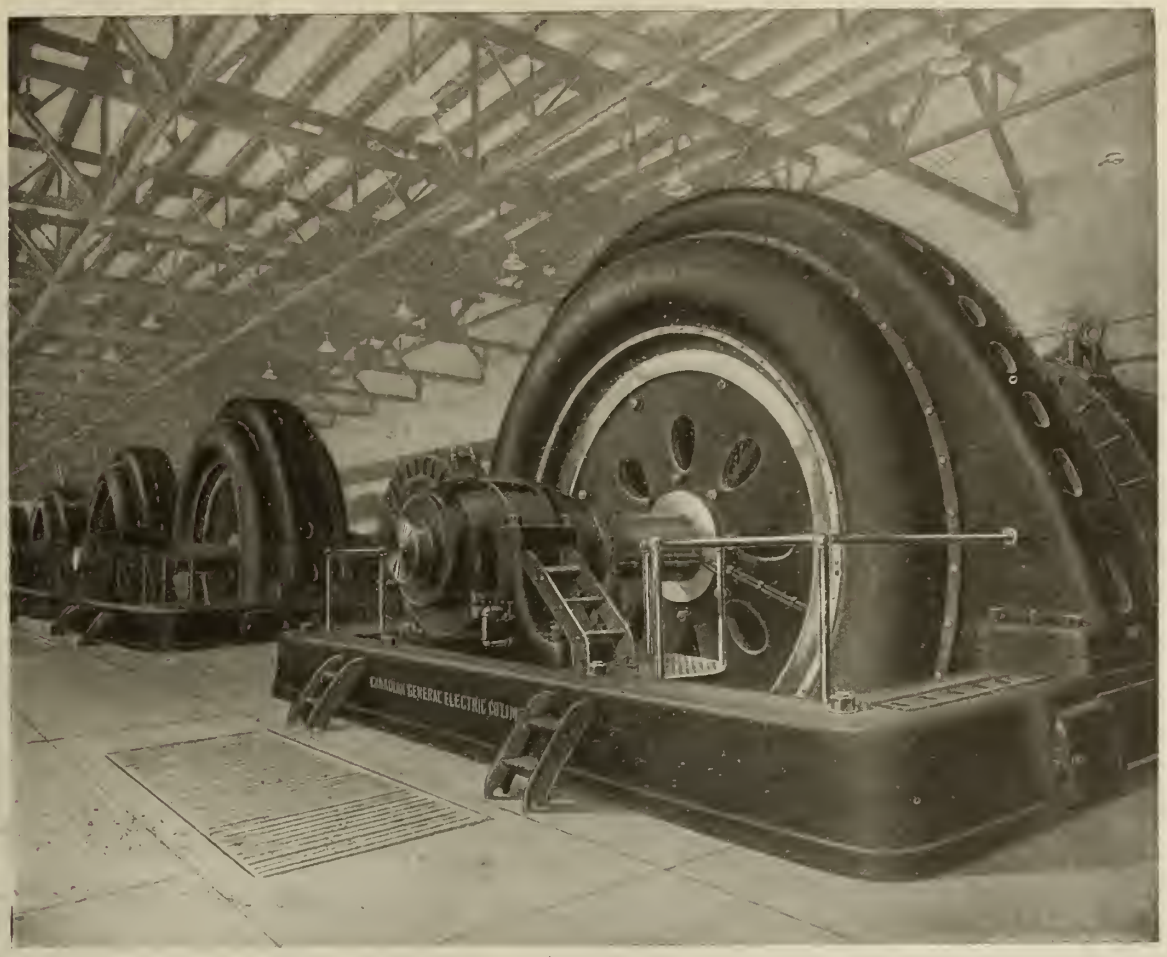

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HEAVY DUTY GOLDIE CORLISS STEAM ENGINES

Nothing but the best quality of material is used in the construction of these Engines, this coupled with the fact that the most skilled Mechanics obtainable are employed, explains why they are to be found in the most modern and best equipped Power Plants in Canada.

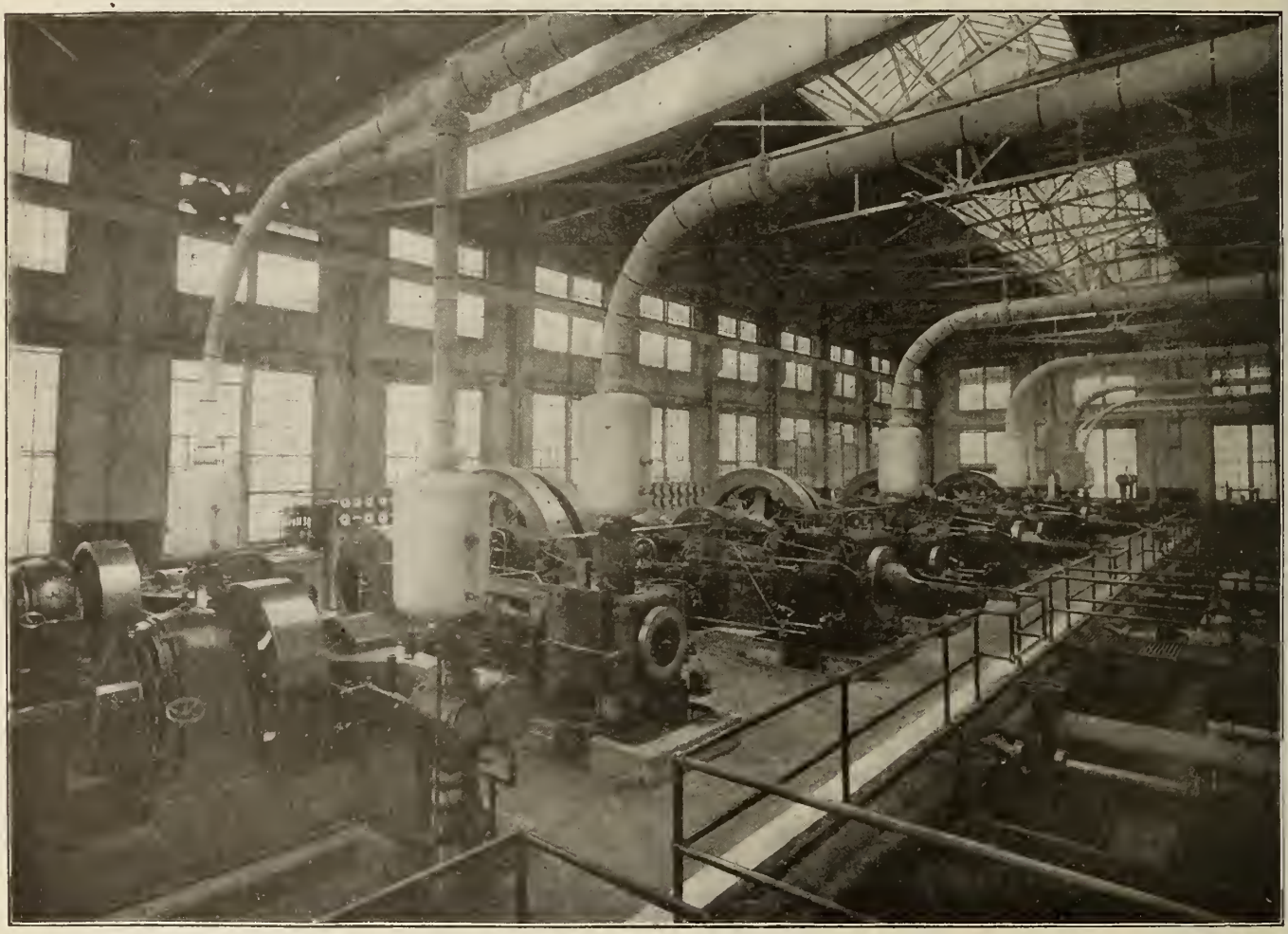

Illustration shows the magnificent new Power House of the Grand Trunk Pacific Shops at Transcona, Man., in which we have recently installed five Heavy Duty Goldie Corliss Steam Engines and two Ideal High Speed Steam Engines.

ASK FOR A COPY OF OUR NEW CORLISS CATALOGUE.

The Goldie & McCulloch Co., Limited

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The advertiser would like to know where you saw his advertisement—tell him.

"Pirahy" Power Plant Extension, Rio de Janeiro L. & P. Co.

By C. T. R.

The outstanding features of this equipment are the largeness of the units, the adoption of the vertical shaft type leading to reduction of first cost, economy of floor space, the application of four nozzles, and the means adopted to secure highest degree regulation and control of operation, etc.

AS may be generally known, some years ago the firm of Escher Wyss & Co., of Zurich, Switzerland, was awarded the contract for the whole hydro-mechanical part of the machinery to be installed in the power plant at Pirahy of the Rio de Janeiro Light and Power Co., Brazil, South America. The plant was, at that time, designed for receiving 6 units each capable of developing 9,000 B.H.P., or having a total output of 54,000 B.H.P.

The rapid growth of the capital of Brazil, Rio de Janeiro, which town is supplied with power and light by the above mentioned plant, brought about a greatly increased demand for electric energy and necessitated the extension of the power house, whereby two more units were installed, each capable of developing 20,000 B.H.P.; the total output of the plant thus approaching 100,000 B.H.P. Also on this occasion, preference was given to the tender submitted by Escher Wyss & Co., and this firm was subsequently entrusted with the design and construction of these two impulse wheels, which are the most powerful of their kind ever produced, together with the necessary penstocks.

Vertical Shaft Turbines.

The initial development consisted of vertical shaft turbines of the impulse wheel type, and the two new units were designed on the same principle. The vertical arrangement of impulse turbines is not very often used and Escher Wyss & Co. is the only firm which has developed this line of turbine construction to any great extent. The advantages to be gained are easily realized. It is possible to place four nozzles around the runner without interfering one with the other, thus developing large power by one single wheel. The cost of the machinery is reduced and the design greatly simplified. In addition, the well-known advantages of a vertical water turbine development are gained, requiring a minimum of floor space, entire separation of the hydraulic and electrical end of the machinery, etc.

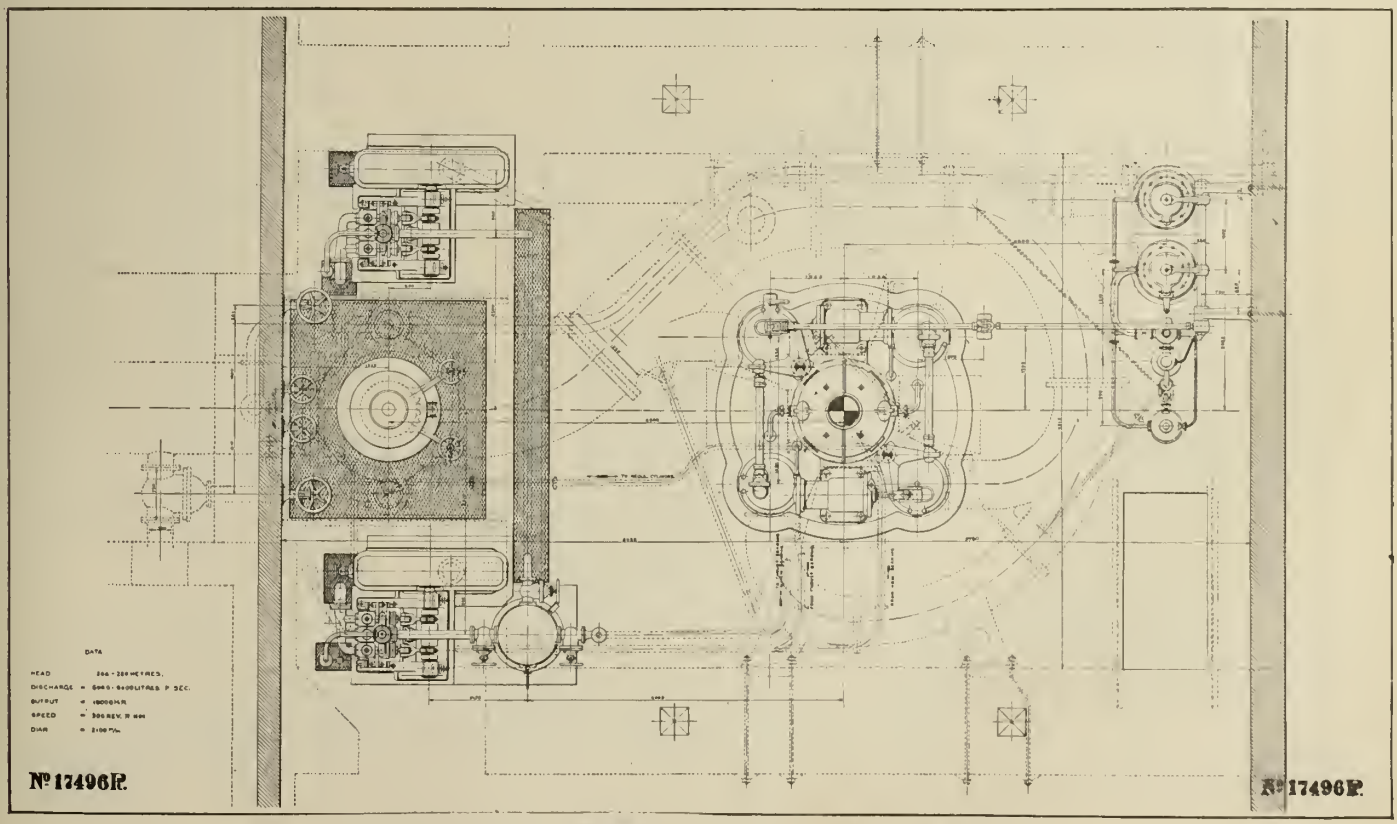
Detail Data.

The wheels run at a speed of 300 R.P.M. under a net head of 900 feet, and the 20,000 B.H.P. is generated by one single runner provided with heavily designed pear-shaped buckets. The wheel is keyed on the end of the shaft and no bearing is provided at the lower end of same. The wheel is a four jet unit, the jets being arranged at 90 degrees distance around the runner. The jet is produced in cast steel nozzles, carefully machined and polished, so as to decrease losses due to friction as much as possible. The amount of water discharged is controlled by steel needles provided with pear-shaped heads moved inside the nozzle, enlarging or diminishing the diameter of the jet. These four needles are connected one to the other, so that they all move simultaneously, the control being effected by oil pressure governors.

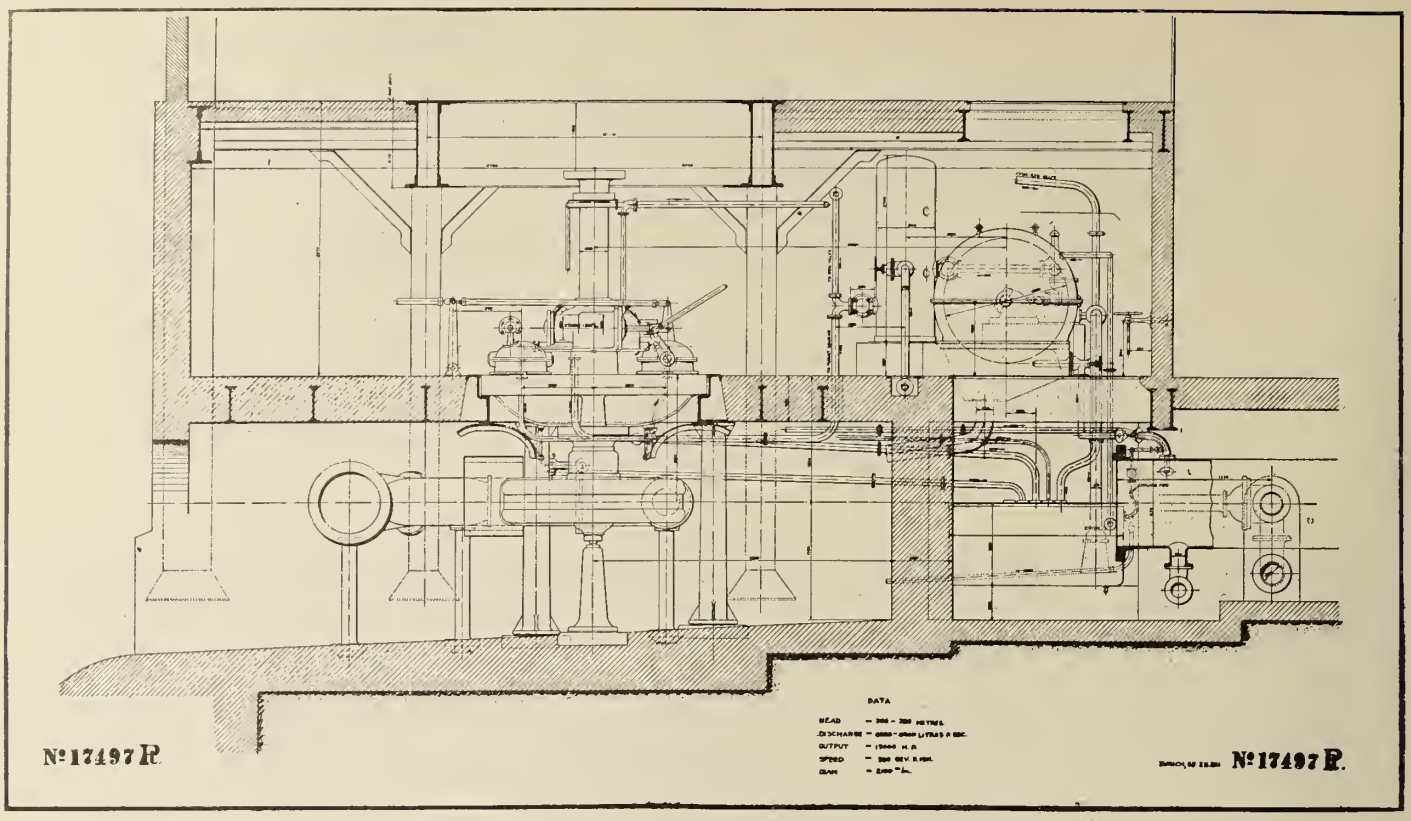
In order to keep the power exercised by the governors constant at any point of their stroke, springs are fitted to the needles to counter-balance the pressure and the friction, which is caused between the high speed water and the needle, tending to close same. The water escapes through the nozzle at a velocity of 235 ft. per second, and the circumferential speed of the runner is 108 ft. per second.

Regulation and Control.

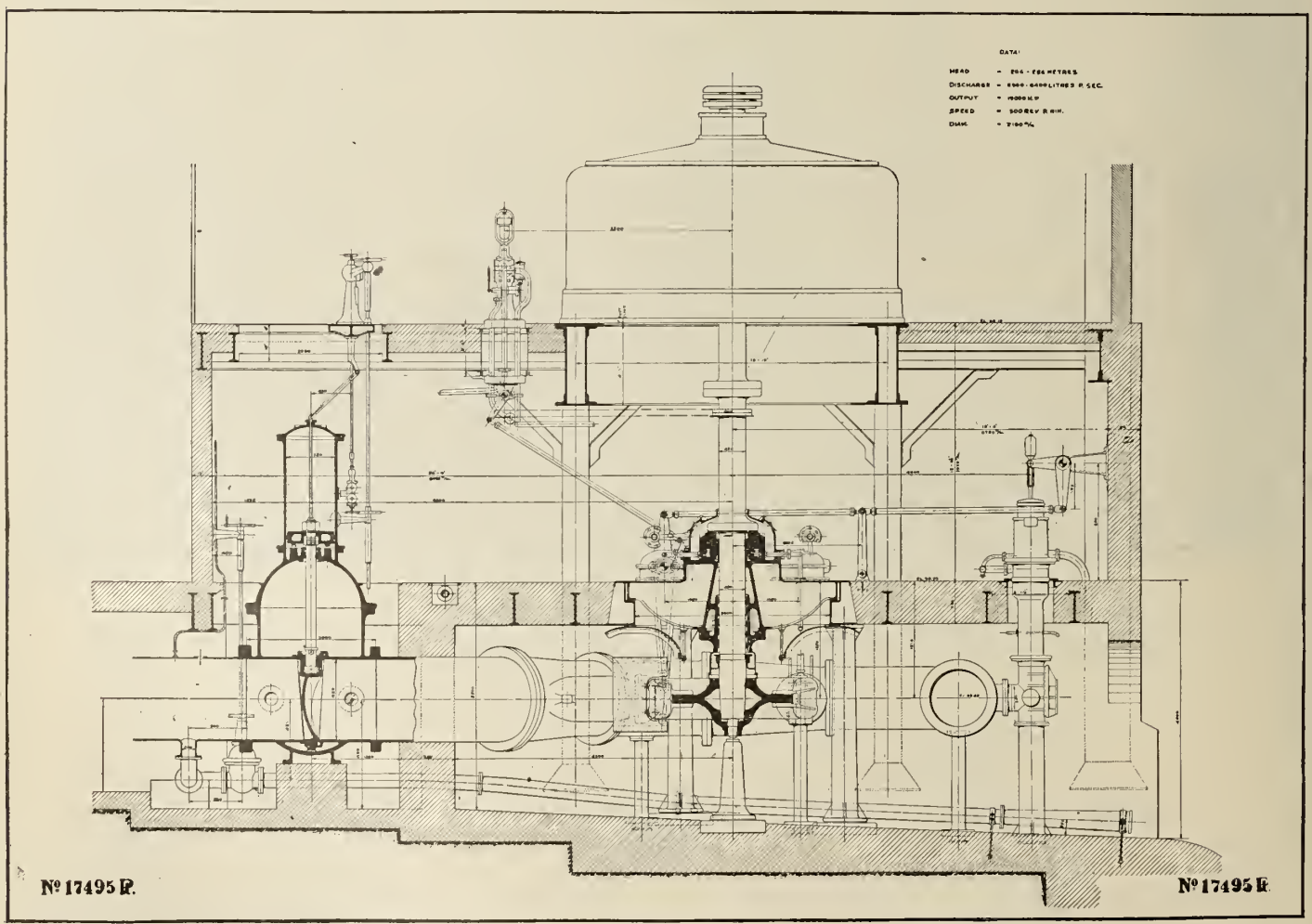
In order to keep, in the event of sudden changes of load, the pressure rise



PLAN SHOWING ASSEMBLY OF 19,000 H.P. IMPULSE WHEEL.



PLAN SHOWING ASSEMBLY OF 19,000 H.P. IMPULSE WHEEL, VIEW OF THE OIL PUMP STATION.



PLAN SHOWING ASSEMBLY OF 19,000 H.P. IMPULSE WHEEL, LONGITUDINAL SECTION.

in the penstock within reasonable limits, one pair of relief valves are attached to the lower end of the penstock, designed so as to discharge the total amount of water consumed by the turbine when fully opened. One of these relief valves is connected rigidly to the oil pressure governor in such a way that failure should be practically impossible. The other is designed to act as an emergency valve and is controlled directly by the pressure in the penstock, the increase of which above a certain point, causes this valve to open. Both valves are provided with a dashpot arrangement so that the valve, when suddenly opened in exact proportion to the movement of the needle, will close down slowly; the closing time being adjustable. By this arrangement, there is no unnecessary waste of water.

Turbine Water Supply.

The water supply to the turbine is shut off by one hydraulically operated gate valve, installed in front, details of which may be seen from the sectional cut. It is handled through the medium of a small controlling valve distributing the pressure water to the upper or lower side of the servo-motor position. A compensating relay is inserted, so that the time required for closing the valve is fixed in order to prevent dangerous shocks in the penstock, even if the controlling hand-wheel is turned as quickly as possible. In this way the valve may be attended by unskilled labor.

General.

The pressure oil required for the operation of the speed governor as well as for the pressure regulator, is furnished from an oil pumping plant comprising 3 high-pressure-piston pumps, system Escher Wyss, capable of discharging a maximum of 80 Imperial gals. per min. The pumps are driven by small impulse wheels, the power being transmitted by gear.

These two wheels have now been in uninterrupted operation for about a year, and have given the greatest satisfaction to the owners. The results have been such that in future impulse wheels still more powerful may be constructed where very large water powers are developed, in order to decrease the initial expenditure and the maintenance of hydraulic plants.

LOSSES FROM EXCESSIVE SHAKING OF GRATES.

DISCUSSING efficiency in locomotive coal consumption, an American engineer of large experience said:—"There are more grates burned out, more coal wasted on account of green coal passing to the ashpan, and more ashpans burned and warped from excessive shaking of grates than from any other cause. The practice should be restricted, and the rule adopted to shake grates as little as possible consistent with the maintenance of regular boiler pressure and steam making capacity.

It is understood that as the ashes accumulate on the grate, the depth of the fire increases and there is an advantage in having this layer of ash on the grate, as it prevents the leakage of good coal, warms to some extent the air passing through it, and perhaps helps to distribute it more evenly. It also prevents the excessive passage of air into the firebox where there are holes in the fire and the coal bed is too thin. The excess air cools the furnace and rapidly reduces the rate of steam production. The strong blast of the exhaust is sufficient to supply the proper amount of air for combustion, and it causes sufficient stirring of the fire to allow the lighter portions of the ash to pass out through the tubes and up the stack. In this way a fire may be maintained for a long run without shaking the grates or causing such a deep accumulation of coarser ash as would prevent the admission of sufficient air to the fire."

NEW BRITISH FACTORY FOR DIESEL ENGINES.

IN spite of the progress which has been made by Continental engineers in the construction of Diesel engines, it is of considerable interest to note that extensive Diesel engine works are being built at Ipswich by the Consolidated Diesel Engine Manufacturers, Ltd., London. This will be the first large factory in Great Britain devoted exclusively to the manufacture of Diesel engines for ship propulsion as well as for stationary purposes.

Located in a most convenient and accessible quarter of the town, with lines from the Great Eastern Railway running direct into the buildings, the new works will be equipped with the latest types of machinery and plant for first-rate workmanship.

Employment will be given several hundred workmen; and provision has also been made to secure additional land in order to cope with the increasing demand for Diesel engines. All preparations are well in hand, and it is anticipated that the works will be in full swing in the early part of the coming year.

Mr. W. T. Batho, managing director of the Consolidated Diesel Engine Manufacturers, Limited, is in Toronto, and expects to visit the Pacific Coast before returning to England.

REPORTING SMOKY CHIMNEYS.

A SYSTEMATIC plan, for keeping tab on the condition of power plant chimneys with respect to the emission of smoke, has been adopted by the Department of Smoke Inspection of Chicago. At stated intervals observations are made every fifteen seconds over a two-hour period, of chimneys in a given district, by means of the Ringleman chart, and the percentage of smoke issuing from each chimney recorded. A list is then made, showing the record of the different stacks in the district, and a copy sent to the owner of each chimney. All cases showing greater than 2 per cent. smoke are listed in the violator class, and become subject to prosecution.

EFFECT OF COMPRESSED AIR ON WORKMEN.

IN England, experiments have been made to test the effects of compressed air upon the human organism, by means of a steel cylinder large enough to contain a man lying upon a mattress and furnished with a glass window and apparatus for gradually increasing, and afterward even more gradually decreasing, the atmospheric pressure.

These experiments show that the evil effects experienced by divers and laborers in caissons are due entirely to a too rapid diminution of the pressure on emerging from the diving-bells or caissons. This is explained by the fact that the quantity of nitrogen absorbed by the body rapidly increases with the pressure. When the pressure is too swiftly removed the absorbed nitrogen forms little bubbles in the tissues, and especially in the capillary vessels, with serious consequences that may be avoided completely by a very slow and gradual return to ordinary atmospheric pressure.

The John Inglis Co., Strachan Avenue, Toronto, have acquired a large section of the prison property, immediately adjoining their present plant, and will erect and equip thereon, one of the largest boiler factories on the American continent.

"Cheap" tools are the most expensive things to purchase. For a week they may run well, but soon their defects will become apparent, and then they will be a worry and hindrance so long as they remain in the shop. The "best" may cost a little more, yet they will give pleasure to the worker in using them, bring profit to the employer and satisfaction to the customer.

Tests of a 1000-H.P. 24 Tubes High, B. & W. Boiler

The tests described in this paper were made on an inclined header Babcock and Wilcox boiler, with superheater and mechanical stoker. The peculiar feature of the boiler is the unusual height; the sections being 24 tubes high.

By B. N. Bump.

THE boiler described and illustrated was erected as an experiment for the purpose of determining, by test and by continuous operation in the regular service of a large plant, the advantages and disadvantages of so high a boiler of the B. & W. type. These tests were made from November 1911 to February 1912. They were expected to answer the following questions:

(a)—At what rating will the highest efficiency be obtained?

(b)—Will the superheat obtained, with the superheater located above the 24th tube, be sufficient to pay for the installation of the superheater?

(c)—Will the last pass of the boiler be effective?

(d)—Can the exit gas temperature be reduced very nearly to the temperature of the steam in the boiler?

(e)—If the exit gas temperatures are close to the steam temperature, will pitting occur in the back end of the boiler due to the sulphur content of the gas.

Boiler and Superheater.

The boiler was built-up of one regular 14-tube section, and above this, with a space of some 11 in. between them, was placed a 10-tube section. The headers of the 10-tube and 14-tube sections were joined by short nipples, making a 24 high header. There are 21 of these sections containing a total of 504 tubes. The tubes are 4 in. diameter and 18 ft. long. There are 3 drums, 42 in. diameter and 24 ft. long. The water heating surface of the boiler is 10,000 sq. ft. Between the top tubes and the drums a Foster superheater is placed containing 1,750 sq. ft. of superheating surface.

The gases make three passes through the boiler. The baffles are arranged to give a gradual decrease in space through the first and second passes in the direction of flow, which tends to maintain the velocity of the gases as the temperature decreases. The gases enter the superheater from the top of the first pass, after traveling over 24 tubes. From the superheater they turn downward through the second pass, upward through the third pass, and then make their exit between the downtakes, and through the rear wall to the stack. The spaces between the header, both front and rear, were packed with asbestos.

Stoker and Furnace.

The boiler is fired by a six-retort Taylor stoker; grate area 62.465 sq. ft., not including any dump grate area. The ratio of boiler heating surface to grate area is 160 to 1. The ratio of boiler plus superheater surface to grate area is 188 to 1. The height of the combustion chamber is about 6.5 ft., and the width of the furnace 12 ft. 7 in., which latter is greater than the width of the stoker to allow for placing a cast-iron wind box on either side of the stoker. This, believed to be a new feature, was tried as an experiment. Previously there had been trouble from the formation of clinker on the side walls

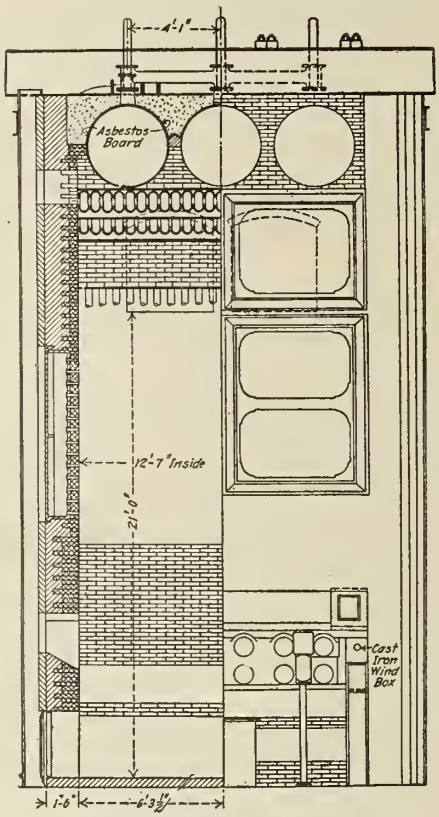


FIG. 2. FRONT ELEVATION OF BABCOCK AND WILCOX BOILER.

with stokers of both the underfeed and overfeed type, owing to some coals giving a tough sticky clinker which is very troublesome. With the side walls against the stoker, clinker forms rapidly, and is difficult to remove. Setting back the side walls lessens clinker formation to some extent, and facilitates its removal.

A brick ledge between the stoker and side wall is objectionable, because in time clinker will fasten to it and make it almost impossible to get a bar between clinker and ledge. The cast-iron wind boxes overcome the objections to the brick ledge by chilling the clinker so that it does not stick. A bar can always be forced between the clinker and wind box to raise the clinker. A part or all of the air from the blast fan is passed through these wind boxes on its way into the stoker. After six months of continuous service there is no sign of burning on the wind boxes.

Fig. 1 shows a sectional side elevation of the unit. On the side elevation, the location of the pyrometer rods and gas sampling tubes are shown. The furnace temperatures were taken through the three openings shown just under the lower tubes. The other gas temperatures were taken at positions 1 to 7 inclusive. The walls were lined with 9 in. of fire brick backed up by 9 in. of porous insulating brick. The outer surfaces of all walls were painted with two coats of boiler pitch to prevent any fitration of air through the brick work. Against these painted surfaces of the front and side walls, 85 per cent. magnesia covering, 4 in. thick was placed. The magnesia was held against the brick and protected by a thin steel shell. Asbestos board was placed on the top half of the drums, then loose mineral wool was placed over the entire top of the boiler.

Test Apparatus and Data.

The tests varied from 18 to 48 hours in length, although most of them were about 24 hours long. The coal was weighed in a wheelbarrow on scales tested frequently for accuracy. A small sample of coal was taken from each wheel barrow load to make up the test sample for moisture, analysis and calorific value. The feedwater was measured in a tank of 13,000 gal. capacity. All feedwater piping was under observation, and any leaks were quickly discovered. The drips from the pump plungers were caught and returned to the feed tank. The feedwater piping being entirely independent, there was no possibility of the measured water going anywhere except into the boiler. The blow-off piping was slip blanked, and the boiler blown down only between tests. The boiler was examined for leaks at frequent intervals, and the boiler tubes were dusted every 48 hours in the intervals between tests. Steam pressures, superheated steam temperatures, and steam calorimeter temperatures were taken by recording instruments.

It was found necessary to have some suction over the fire to prevent the escape of gas into the boiler room. This suction was kept as low as possible. Gas temperatures were taken at seven different points. The seven pyrometer rods were wired to one indicating instrument, so that, by the use of knife edge switches, the indication of one rod after another could be taken in quick succession.

A high reading pyrometer was used for furnace temperatures. There was considerable trouble in keeping this pyrometer in working order and consequently the furnace temperatures are given for only a few of the tests. Samples of gas for analysis were taken in the first pass at the top of the 14th tube, and before the breeching. The samples were taken through six sampling tubes placed in the space between the boiler and back wall, and directly in front of the opening to the breeching. One tube was connected to a CO_2 Recorder and the other five were attached to large sampling bottles which were run continuously. The tips of the tubes were so placed that the samples taken through each represented approximately equal volumes passing to the stack.

The first 19 tests were made with mixed coal, from four different mines all in the same region. Tests Nos. 21 to 40 were all run on coal from No. 29 mine, lighter than that used in the early tests and giving much less clinker trouble. It made a loose fuel bed and allowed more boiler capacity with less draft in the stoker. For best combined efficiency, the dry coal per square foot of grate per hour is about 26 lb., or nearly 270 lb. per retort. The quantity of coal burned per square foot of grate per hour was increased to nearly 63 lb. with a decrease in combined efficiency of 5.5 per cent. To determine the carbon in the refuse, the total refuse was spread out upon a large floor, broken up, thoroughly mixed and quartered. The quarter sample was ground, and this ground portion was in turn quartered to get the sample for chemical analysis. The calorific values of the coals were determined by the oxygen-bomb calorimeter. The radiation and unaccounted-for-losses have been calculated for those tests, for which there were ultimate analyses of the coal. The tests were made during extremely cold weather, and there was over the boiler only a temporary building affording but little protection from the elements; the boiler room temperatures were so low at times, the boiler pressure gage piping and the water column blow-off piping froze. In view of these facts and the drafty condition of the boiler room, the radiation and unaccounted for losses of from 5 to 7 per cent. are worthy of note.

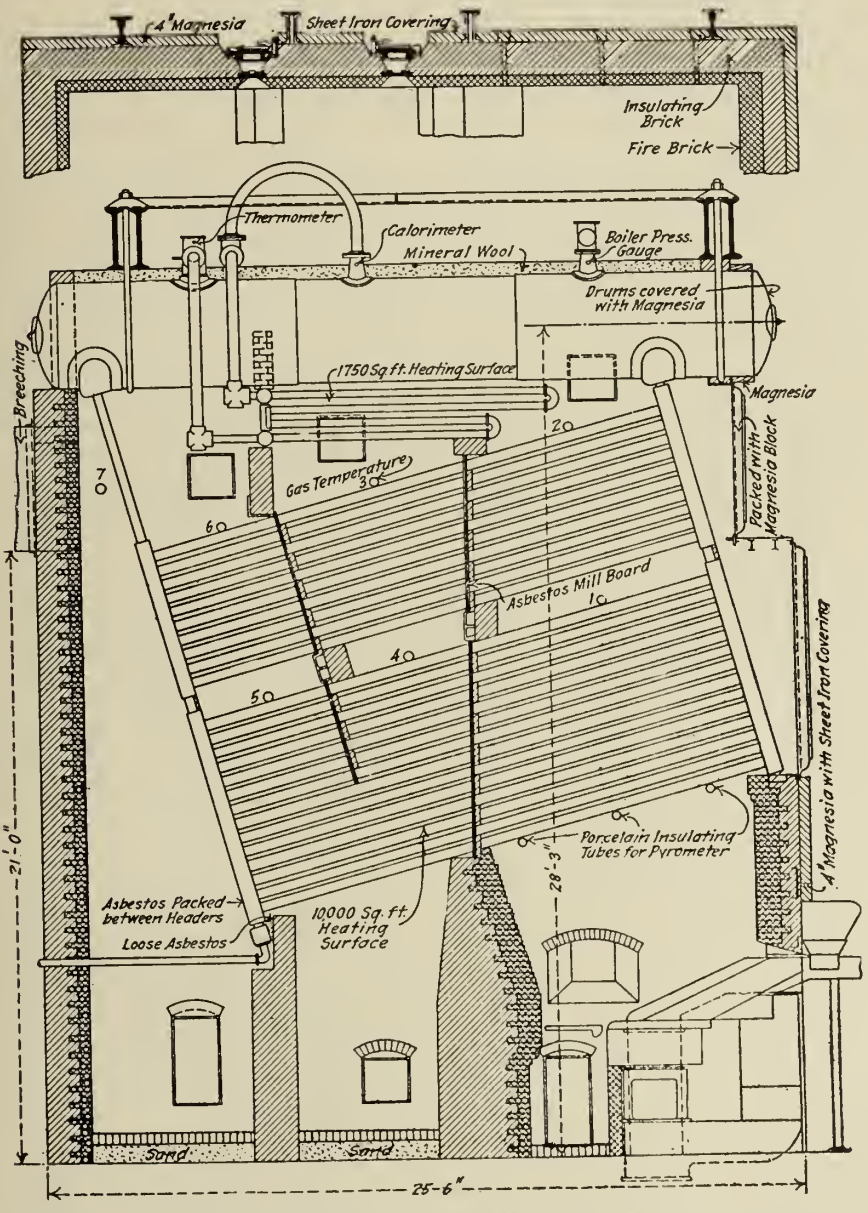


FIG. 1. LONGITUDINAL SECTION OF BABCOCK AND WILCOX BOILER.

The theoretical efficiency was calculated on the assumption that the only heat loss was that to the stack when the combustion was complete without excess air, and the temperature of gas leaving the boiler was equal to the temperature of the wet steam in the boiler. The efficiencies in Table 1 have been calculated for those tests for which there were ultimate analyses of the coal.

It may be possible under favorable conditions to reduce the radiation losses to 2.5 per cent. With thorough mixing and a suitable type of combustion chamber, the heat losses in the gas may be expected to be not more than 1.5 per cent. greater than the theoretical gas loss; the maximum combined efficiency which may be attained under these most favorable conditions is about 85 per cent.

TABLE 1—THEORETICAL EFFICIENCIES.

No. of tests.	Theoretical Efficiency, %	Combined Efficiency, %	Gain in Efficiency necessary to attain Theoretical Efficiency.
8	90.10	79.60	10.50
11	90.15	78.14	12.01
16	90.05	76.18	13.87
18	89.95	75.20	14.75
25	89.52	75.79	13.73
35	89.90	78.33	11.57
39	89.85	78.65	11.20

Summary of Results.

The best combined efficiencies are obtained with 56 to 66 per cent. of the boiler rating. The efficiencies fall off slowly as the quantity of steam generated is increased. The extreme variation in efficiency shown by the individual tests is from 75.2 to 81.3 per cent. The gain in efficiency due to the superheater seems to bear no definite relation to the amount of moisture in the steam entering the superheater. By gain in efficiency due to superheater is meant the heat absorbed by the superheater in percentage of the total heat in the coal. The superheat shows a general tendency

upward with the increase in boiler rating. For 60 per cent. of the boiler rating, the superheat is about 36 deg. Fahr., and for 120 per cent. rating about 74 deg. Fahr. At 60 per cent. rating, the weight of steam passing through the superheater is 18,000 lb. per hour, the amount for which the superheater was built. The pressure drop through the superheater for its rated quantity of steam is 5 lb.; at 120 per cent. boiler rating the weight of steam passing through the superheater is double that for which the superheater was designed, and the pressure drop through superheater is 28 lb.

At the low boiler ratings, the last pass of the boiler, and in fact the last two passes, are of very little use. The best combined efficiencies were obtained when running between 56 and 66 per cent. of boiler rating. At these low ratings the drop in gas temperature through the second and third passes altogether is about 20 deg. Fahr., and the heat absorbed is very small, about 1.3 per cent. of the total. These two passes have 50 per cent. of the boiler heating surface. If the second and third passes were dropped off entirely, the loss in combined efficiency would be about 1 per cent. at the low rating. It is only when the boiler has reached 75 per cent. rating or more that the gain in economy in the last two passes is sufficient to give a reasonable return upon the investment in heating surface. While the exit gas temperatures were reduced almost to the lowest theoretical limit which can be reached without the use of an economizer, it was done at a large expenditure in heating surface.

When running at about 50 per cent. of boiler rating, the temperature of the gases leaving the boiler is practically that of the steam in the boiler. As the capacity is increased, the difference between the temperature of the gases leaving the boiler and the temperature of the steam in the boiler increases. The increase in the difference between these two temperatures seems to be approximately in the same ratio as the increase in capacity, so that for an increase from 50 to 100 per cent. of the boiler rating, the difference in temperature between exit gases and steam increases about 50 deg. Fahr.

An examination of the boiler after more than six months' service showed no evidence of pitting of the heating surface of the last pass due to the sulphur content of the coal and low exit gas temperature.

INTERESTING DATA ON THE FUTURE OF OIL FUEL.

COAL has served its purpose. For years it was good enough for the production of power, but to-day there must be speed, and coal is too bulky for the power it produces. So the nations are turning to oil. Coal could not very well be used to make the engine work on a motor-car, and it would be decidedly out of place on an aeroplane. It is likely soon to be as much out of place on a battleship or a liner. Coal wants a lot of handling, and manual labor is uncertain and costly. The furnaces on any big boat require a small army of men to feed them. It is an economic waste of good material to keep men grilling in a baking firehole at unnecessary labor. The effective strength of a navy would be increased by one-third if oil were used in place of coal, owing to the fewer number of men required to man the vessels. The demand for oil has overtaken the supply. Not that Nature has been niggardly in storing oil, but to carry it from the oilfields to the user, the means are insufficient. The ship-building yards are full of half-built tankers and before a year is out, oil is likely to be in abundance where demand for it exists. Oil is not a cheap fuel, but is is cheap when the advantages are taken into consideration.

Oil-Getting.

From oil we obtain scores of by-products. It may be said to be used in one hundred and fifty different ways in commerce, science and art. Oil, as Nature gives it, is simply a sticky, rather repulsive looking liquid; but refined and manufactured, it yields the clear liquid of petrol, the whiteness of paraffin wax, and the inoffensiveness of vaseline. Oil-getting is a speculation. No one can ever tell definitely whether or not it can be located in a bore. The lucky ones get it at the first try, others have to sink and sink again until success comes. Boring is expensive. Of course there are shallow wells that cost but little to sink, but those are generally soon exhausted, although they may give big profits on the capital invested. The big paying oil sands are usually found at depths of hundreds of feet, but when found they pay well for the cost of boring, when big productions are obtainable. Shareholders do not always get the profits, it is true, but that is not the fault of the oil well. An over-capitalized company, or one where money has been wasted, does not affect by its non-success the fact that oil boring is a profitable pursuit. The profit is there. If it has to be spread so thin that the layer can hardly be noticed, that is usually the crime of the promoter or the incompetence of the directors.

Boring For Oil.

The boring of an oil well is an interesting operation. It is proposed to show at Olympia at the Oil Engineering Exhibition this month how a bore is sunk and, no doubt, the operation will prove a great attraction, not only because it will show how the work is done, but also teach us something of the strata beneath. At a depth of 2,000 feet something may be located, which may remove the reproach that there is no oil in England. Of course, oil has already been struck near London, but it was only a little show, and the depth at which it was struck was only about 600 feet. We have also had small flows of oil in the coal regions, but they dried up before they could attract much attention. We believe at Battle a bore sunk to about 1,500 feet struck shale, but the boring tool was lost, and as money gave out, the investigations ceased.

To dig a hole a few thousand feet deep is a long job, and requires a lot of patience and a good deal of money. The method of boring has been described at length, both in our handbook on oil and in various periodicals, but, roughly, a scaffold, called a derrick, is first erected, and then a weight, with a chisel-like arrangement at the end, is hoisted a few feet and dropped on the ground, pulled up again and dropped, and so on for months. The chisel gradually digs itself into the earth and a slight twist to the weight as it falls keeps the chisel smashing up the ground in a circle. After a certain distance is sunk a casing of sheet iron is slid down the hole to keep the sides of the hole from slipping in. The debris is pumped out of the hole, which is usually kept half full of water.

Sometimes when oil is struck there is such a pressure of gas that the boring tool and casing are blown into the air, carrying the derrick with it. That is a gusher. With the gas and oil come stones and sand torn from the sides and bottom of the hole. These fragments often stick in the bore, and then a cork is formed which stops the flow of oil. When oil is struck, if it does not come to the surface of its own accord, it is pumped or baled up. It is stored in tanks and finally conveyed by pipe lines to the refinery. Refining and oil-getting are generally two distinct businesses. A refinery costs a lot of money to erect, but makes considerable profits. It is in refining that the Standard Oil Company earns it enormous profits. It buys the crude oil, refines it, and markets the products.

The Work of the Refinery.

The refinery distils the crude oil by running it into a still and applying heat. At the top of the still is a dome with an outlet for the hot vapour, which is carried by a pipe to the condenser. The condenser is a series of pipes something like a radiator on a motor-car, and is cooled by water running over it. The hot vapour condenses into liquid form and runs into a tank. When the still is heated the oil evaporates. At the first stage, the vapour, when condensed,

is petrol. When the oil gets hotter the vapour becomes paraffin.

At one time the principal value of crude oil lay in the kerosene it contained. Petrol was of little value, and, in fact. was thrown away as valueless. Roughly speaking, crude oil contains twice as much kerosene as petrol. When engineers began experimenting with an oil for power production they naturally tried to use that portion of the crude oil which was of least value, and so designed engines to use petrol. Times have changed since then, the least valuable has become the most profitable—for the distillers. After the kerosene has been driven off, heavy lubricating oil is obtained, and then what is left is bitumen.

These are, roughly, the principal constituents of crude oil, but naturally there are many different minor products obtained, such as paraffin wax, vaseline, etc. As might be expected, the character of oil differs in different countries. Some oil contains a lot of petrol and kerosene, and others very little. Some of the Californian and most of the Mexican oils give a very small proportion of light oil, and are really only suitable for heat-giving or fuel oil. The oil used in furnaces is rather a treacle-like liquid and has to be sprayed into the firebox of the furnace. Broken up by air or steam into a fine rain, it burns easily and is used as fuel by all the torpedo boats and torpedo boat destroyers of the Navy. The furnaces of all the bigger boats, such as cruisers and battleships, are all fitted to burn oil, and some of the latter Dreadnoughts, such as the Lion, carry nearly 1,000 tons of oil.

The burning of oil, however, is a roundabout way of getting power. The motor-car and the aeroplane take little drops of oil and explode them in cylinders, and get all the power required without being bothered with furnaces, boilers and steam engines.

Advantages of the Motor Ship.

The new motor-boats follow the lead of the motor-car, only instead of using petrol, heavy or residue oils are used to get the power impulses. A vessel using a motor engine does not want so big a crew, the engines do not take up so much space, and the oil can be stored anywhere. There is no coal to be fed into the furnaces: a pump forcing the oil from a tank to just where it is wanted. The space saved can be used for cargo. With a smaller crew and more room to carry cargo, motor-boats can earn more and cost less to run than steamboats. The crew carried has less to do, as there is no firing.

Locations of Oil.

Oil is found nearly all over the world. As we have said, it has even been found in England, but only in small quantities, although no one has tried boring at appreciable depths, and it is by no means improbable that oil may be found underneath the coal measures. Shale, a slatey clay containing oil, is found in Scotland and a large quantity of oil is distilled from it; but it is a round-about method to get cheap oil, and the treatment of shale would not pay were it not for the by-products obtained when distilling. These by-products are chiefly paraffin wax and sulphide of ammonia, which is worth about $65 to $70 per ton.

Treatment of Illuminating Oils.

The illuminating oil is next treated to remove the unpleasant odour and color and eliminate the impurities which interfere with combustion. The process is very nearly the same as described for the naphtha, except that more time is usually employed. The acid is often added in three different portions, the second and third being allowed to act for three-quarters of an hour each, and to settle for an hour before being drawn off. After the soda solution has been used and the oil again washed, it is often put into shallow pans for "sunning," which further lightens its color, and poured into a steam still, where sufficient heat is applied to drive off the more volatile parts. This reducing process is continued until the oil will stand the required fire test, and becomes safe to use in ordinary lamps.

Flash and Fire Test.

Illuminating oil is tested for acid, sulphur, gravity, color and flash and fire points. The acid and gravity tests are the same as for the naphtha oil. The color decides the grade of the kerosene as water white, which is colorless; prime white, of a faint yellow color; and standard white, a pronounced yellow. The flash and fire tests are the most important. If there is too much of the heavier part of petroleum in kerosene it does not burn easily or freely, while the presence of too much of the naphtha group makes the oil unsafe to burn in lamps. To be safe, kerosene should have a flashing point higher than any temperature that is likely to be encountered. This point is usually fixed at 150 degrees F. for water white, 120 F. for prime white, and 110 F. for standard white.

The flash test is made as follows:—The oil is slowly heated, as a result of which a vapour is given off the surface. When the oil reaches such a temperature that a lighted taper passed over the surface ignites the vapour in a pale blue flash or flicker, the flash point is determined. As the temperature rises the oil becomes so heated that a point is reached where it takes fire on application of the flame. This is the burning point or fire test.

The wax oil is put back into the fire still and redistilled. It is then chilled and run through hydraulic filter presses at a temperature of zero. The presses squeeze out the oil and the wax is put into pans and again heated and fired until every trace of oil is gone. It is then filtered through bone black or Fuller's earth until all the color is removed, and again put into the chilling tank and crystallized. After another trip through the presses it is ready for the market.

Paraffin wax is used for candles, oil paper, laundry work, preservation of foods, artificial flowers, insulation in electrical work, and the like. The oil which has been squeezed from the paraffin wax is taken back to the steam still and by a reducing process brought to certain fire tests and gravity. After filtration through Fuller's earth to various colors it is ready for sale as light machinery or engine oils.

Heavy Lubricating Oils.

The residuum furnishes the heavy lubricating oils. It is steamed, filtered and compounded until cylinder oils under a hundred different names result. Lubricating oils are subjected to the tests mentioned above, and, in addition, to viscosity and cold tests. The viscosity determines the glutinous quality of the oil and its value as a lubricant. The test is made by noting the time required for a given quantity of oil at a certain temperature to flow through a small orifice of a stated size. The cold test is the temperature at which the oil thickens and ceases to flow. This test determines the value of the lubricating oil for use at low temperature or in cold weather.

The purpose of lubricating oil is to overcome friction, whether on outside or inside steam and gas engine cylinders. In steam cylinders there is a varying temperature and considerable moisture, and it is sometimes necessary to add enough animal oil to take care of it. In gas engine cylinders the problem is different. The heat is dry, and the oil comes into direct contact with the flame. In this intense heat much of the oil is burned up.

The residue remaining after the lubricating oils have been taken out of the residuum may be solid coke, tar or asphalt, which are now employed in the manufacture of various by-products, such as carbons for electric lights, asphalt for street paving, and others. Vaseline is another product of petroleum, which is too well known to describe. It is a trade name for petroleum jelly, which is made by special processes from the residuum of crude petroleum. Experiments are now being conducted with a view to developing petroleum from an industrial and economic point of view, and these experiments are being kept a secret; but in general it may be said that the attempt is to change the hydrocarbons into fatty substances and then

by mixing them with other substances convert them into foods and butter substances and the like. In spite of the great number of products now being made from petroleum, it seems safe to assume that new and unthought-of combinations will be discovered and that crude petroleum will retain its supremacy as one of the greatest of natural products. It will be seen that oil fuel is only a small part of the value of oil, although as fuel or spirit oil it is most familiar to the world in general. The foregoing is from a statement recently issued by H. S. Stoneham, London, England.

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SAWMILL REFUSE AS FUEL IN GAS PRODUCERS.

By Chas. E. Snypp.

THE following is a brief account of the writer's experience in the firing of the following fuels in gas producers—namely, bituminous coal, anthracite, coke and coke braize, and sawmill refuse. Our producer plant was installed for the purpose of burning Pittsburg bituminous coal, guaranteed to furnish gas of about 125 B.t.u. to the engines. As a matter of fact, we operated the plant continuously for about four years on various kinds of coal.

Capacity of Producer Plant.

The producer used was a pressure type Wood. The capacity of the producer plant was 840 h.p., consisting of a combination of three units each having a producer shell 8 ft. diameter by 12 ft. high with steam jacketed top; one wet scrubber 5 ft. by 18 ft. high; one dry scrubber 8 ft. diameter by 3 ft. high; one pressure fan; one gas holder, and one motor-driven mechanical tar extractor.

The coal was locked through an air-tight hopper into each of the producer shells. When poking the fires, the gases under pressure from the blast escaped freely through the poke holes, causing great distress to the workmen. To overcome this difficulty, we installed a fan between the dry scrubber and the tar extractor, intending to bring the producer shells under a slight vacuum. This relieved the men of the gases and yet retained our pressure in the holder, thus forcing the gases to our engines under pressure.

After the producer gases are formed, they pass into the wet scrubber, which is an enclosed tower of slats, wherein the water passes in a downward direction and the gases pass upward. The gases are then conducted to a centrifugal mechanical tar extractor which removes most of the tar, and then to a dry scrubber, which is a shell about 8 ft. diameter, packed with excelsior in layers. The gases next pass through an exhaust fan to the holder and thence to the engines.

Tar Congestion.

The first coal burned was Pittsburg bituminous, but we found that while this fuel filled the requirements as far as the richness of the gas was concerned, our plant went out of commission at regular intervals in consequence of tar congestion. These intervals came closer and closer together the longer we operated the plant on this coal, on account of greater and greater accumulation of its peculiar heavy tar. In fact, the tar was too heavy for the centrifugal tar extractor, and breakdowns on this machine were frequent. This led us to try other bituminous coals with the idea of reducing the tar nuisance.

After four years of continuous service of the producer plant on various bituminous coals, we found that in spite of our selection the whole system of pipes and engines was becoming congested with tar. We also found that it was quite an expensive repair to remove this tar from the engine cylinder rings. In fact, many of the rings had to be cut from the grooves with a cold chisel. We found that a gas plant could not be run for more than five hours on gases from Pittsburg bituminous coals without taking out these tars, as the valves and piston rings would stick. Alabama coals did not do much better.

These Alabama coals were analysed particularly for fixed carbon and volatile matter in order to select those with a high fixed carbon and a low volatile matter. They gave greater satisfaction because of the reduced quantity of tar, and at the same time furnished a gas that was just as rich as the Pittsburg bituminous—namely, about 125 B.t.u. The Alabama coal, however, introduced a trouble peculiar to itself, which finally forced us to abandon it. The first trouble was that the fuel came to hand of irregular quality, even from the same mine, particularly as to volatile matter and ash.

The content of ash was especially unsatisfactory and very irregular, varying from 6½ to 11 per cent. Not only was the content of ash high, but it had the peculiar property of fusing in the producer or forming a solid clinker, which was almost impossible to penetrate with poke bars, and even after penetration with bars and sledges, was not brittle enough to break in pieces of a size that could be readily removed from the producer itself. Besides this, the act of fusing cuts off the air from the fuel beds, producing a lean gas, or one low in B.t.u., finally putting that particular producer out of business.

We next resorted to the experiment of burning anthracite coal. Our experience was limited to a few tons, but the conclusion reached was that we could not produce a gas high enough in heat value. The best condition did not yield much more than 100 B.t.u. in the gas; besides, this fuel was too expensive.

Experiments with Coke and Coke Braize.

The next experiment was to substitute coke and coke braize for anthracite. This furnished a fair quality of about 110 B.t.u. gas in the beginning, but we experienced great difficulty in the producers filling up with ash, and the ash fusing, thus causing cavities which could not be poked out. The quality of the gas sometimes fell as low as 80 B.t.u., thus putting the plant out of commission. When this happened we would have to cool down and sledge the clinkers. I noticed that when the gas became lean we could raise the heat value of the gas by feeding the producer with barrel staves, which would keep us running.

Improvement Period.

During this interval numerous improvements on the producer plant were made, as follows:—

First, the "Z" pipe which conducts the gases from the producer shell to the wet scrubber would frequently become clogged with dry soot, and we found that on account of the bends in the pipe this soot would bake in hard clinkers, thus reducing and eventually choking the pipe. This pipe was replaced by a horizontal pipe extending between the producer shells and the wet scrubber, and a partition was run vertically in the wet scrubber, thus making a downtake which opened directly into the bottom of the wet scrubber.

Second, we found that tar was accumulating in the bottom of the wet scrubber and was very difficult to remove. The metal bottom was replaced by a water seal, extending all over the bottom of the wet scrubber. All other pipes where the gases have a downward trend and a sharp bend were similarly provided with water seals, in order that the tar might readily drop and wash out, thus facilitating the cleansing of the producer.

Sawmill Refuse Adopted.

On account of these various troubles and because of the increase in heating value of producer gases made with barrel staves referred to before, I was prompted to try sawmill refuse in the producers, and found very much to my satisfaction that we were able to operate the plant continuously on about 130 to 135 B.t.u. gas, and the plant was more reliable on account of the even quality of gas. After about a month of use of this refuse fuel our tar troubles began to disappear, and now after using this fuel for a couple of years it is a very rare occurrence to have an inlet valve or an exhaust valve stick in the engines on account of tar, or carbon deposits. In fact, we have discarded the dry scrubber altogether and we even

operated one week without a tar extractor at all, on account of that machine needing repair. This illustrates how well the sawmill refuse has solved the problem in our case when it is recalled that we could not run even five hours on coal without removing the tar.

The refuse that we use is known as "cypress hog." It consists of about 50 per cent. of sawdust and 50 per cent. of chips, such as are discharged from the "hog," which is a machine used by sawmills to destroy their refuse. This material runs from 30 to 55 per cent. moisture, and this moisture seems to be necessary for best working conditions. We have to guard against the sawdust blowing over into the pipes which conduct the gases to the wet scrubber. This is probably a local trouble, due, no doubt, to the strength of the blast that we use in order to get capacity. We have been able to realize full capacity using sawmill refuse, and our engines deliver a brake horse-power on about 4½ lb. of this fuel.

Necessary Changes Unimportant.

The changes necessary to fire sawmill refuse are merely the removing of the coal dump hoppers and substituting a hollow cylinder about 10 ft. high slightly tapered and made larger at the bottom and fitted with a slide gate at both top and bottom; these slides are worked with levers and the sawmill refuse is locked into the producers through these tubes.

To start firing a producer with sawmill refuse, it is not necessary to have an underlying bed of cinders or ash to cover the blast pipe. The fuel can be dumped in on the water seal and fire can be started either on top or through the side poke holes. Aside from these conditions, the beds seem to be subject to all conditions prevalent in the firing of coal. A clinker is formed of a brittle nature and can be easily removed with the fine ash. The percentage of ash is so small that a producer can be operated about three weeks before removing the ash.

Operating Care.

Cavities and chimneys will burn in the bed, and eternal vigilance and poking are necessary to produce a uniform quality of gas. In order to lessen the labour of poking, it is good practice to feed occasionally, say, once a day or when the quality of the gas fluctuates, one or two charges of blocks ranging in size from stove lengths to 15 in. in diameter. These blocks will find their way into the cavities and stop the chimneys, and the producer will respond instantly. I have had cavities form low down in the beds, and cause trouble, but we have always succeeded in poking down overlying fuel and closing this cavity.

"Pine Hog" Also Efficient.

We also experimented with "pine hog," and we find that it is a more efficient fuel for producer gas than "cypress hog." An average of ten analyses made on gas produced from "pine hog" showed 161.4 effective B.t.u. against 130 to 135 for cypress. The reason for this is probably due to the greater heat value of pine itself as compared with cypress. The analyses of heating value of these two fuels showed that the cypress was 5.540 B. t.u., while pine was 7.605 B.t.u. These are on fuel as received, and, therefore, include moisture. The only reason that we do not use pine is that cypress is more available as far as our plant is concerned, which means that it is cheaper, comparatively speaking, although it is pound for pound a much richer fuel.

Summary.

To summarise:—The advantages to be derived from burning sawmill refuse where it is available are as follows:—

First, little ash, therefore, little cleaning to be done.

Second, high-grade gas—that is, gas of higher heat value as compared with other fuels in our type producer.

Third, a lesser quantity of tar, and much more limpid in character.

Fourth, gas of constant quality with less labor.

Fifth, no deadly gases to overcome the workmen.

Sixth, and finally, the all-important factor of lower cost per h.p. hour must not be forgotten.

In conclusion, I wish to explain that there is no intention on my part of casting any reflection on the producer or the original installation that we had. I believe that we were among the first to burn bituminous coal in our section and our work was of such character that the producer plant had to be operated twenty-four hours a day and sometimes on Sunday. Paper read before the Louisiana Engineering Society.

POWER, PUMPS AND RESERVOIRS FOR BOOSTER SERVICE.

A GREAT variation in the head pumped against, to reach various parts of a town with running water under pressure, has long been recognized by waterworks men as a legitimate cause for installing booster pumping service. Of late other considerations, such as increased economy, greater reliability in operating conditions and more satisfactory service to the consumer have formed the basis of a study to determine the advisability of installing booster pumps in existing works. The conditions calling for this class of pumping service, and the economic considerations affecting the choice of power, pumps and reservoirs for booster service, were discussed by H. E. Cole, Vice-President and Chief Engineer of the Harris Pump Supply Co., of Pittsburgh, in a paper before the Central States Water Works Association.

Service Requiring Booster Pumping.

There are at least three kinds of service requiring booster pumping.

First.—Tall buildings which are located on streets where the service is sufficient for ordinary requirements, but where, owing to the height of the building, the normal pressure of the system is inadequate. In this class, apparatus is usually installed by the owner of the building to boost and store a sufficient capacity for ordinary requirements. It frequently happens, however, that the cost of installing equipment, and operation in addition to a high water rate, causes many owners to drill wells, or otherwise take care of their own requirements. Should the water company, however, keep posted as to the simplest way of meeting this condition, the author believes that many large consumers would be retained for the company. Some of the methods suggested for the next class will be equally well adapted for this as well, so will be referred to later.

Second.—Small sections of a city's population are frequently located on elevations higher than the reservoir, or where the pressure is insufficient for their requirements. This is a condition which a great many companies have to face. To meet this demand the following conditions must be taken into consideration and carefully studied: 1.—The population to be supplied. 2.—The distribution of population. 3.—The pressure to be maintained. 4.—The importance of uninterrupted service. 5.—Amount of storage required. 6.—Kind of power available. 7.—Accessibility by regular employe of company.

Meeting the Conditions.

(1)—The number of consumers to be supplied determines the capacity of plant to be installed. The class of consumers being considered in order to determine the probable per capita consumption. The reasons are obvious.

(2)—The distribution of the population determines the location of the booster station and reservoir with reference to the city main bringing in the supply. It, furthermore, makes necessary a careful study of first cost of large mains, low friction losses of small mains, and necessary increase in pressure to overcome friction head.

(3)—The pressure to be maintained has a very important bearing, as it determines largely the character of the reservoir to be used, as well as the type of pump to be installed.

(4)—The importance of uninterrupted service has its effect on both the quality of apparatus and on the duplication of units, as well as on the power employed and attendance.

(5)—The amount of storage required usually determines the kind of reservoir which shall be used. If the pump is to operate automatically, then the storage required may usually be very much smaller than otherwise. Then, the determining factor is the amount of storage required for fire protection or to supply the sections during the probable shut-down of the pumps or loss of power from any cause. Four classes of reservoirs may be used for this work, depending on the size and sites available. If there are high hills available and reservoir is large, then the open reservoir with concrete and earthen walls may profitably be used. If the country is flat and the storage capacity required is large, a steel standpipe is generally the solution. If the required storage is moderate an open tank mounted on a steel structure is frequently used, although steel pressure tanks located at any convenient point may often be used to advantage. If the storage required is small, the steel pressure tank, regardless of the required pressure, has a decided advantage.

Nature of the Power.

(6)—The kind of power available materially affects the cost of operation, not only on the relative cost, but on the adaptability of the power.

(a)—If steam is the power used and coal the fuel, the coal must usually be hauled a long distance and at a high elevation. Steam must be kept up most of the time. An attendant must be present practically all the time the pump is in operation. The smoke nuisance must also be contended with.

(b)—Natural gas for steaming, when available, is far better than coal, as hauling is practically eliminated, and there is no smoke. In such cases, however, a small amount of coal should be kept in reserve and the boiler equipped to use both gas and coal in order to be prepared for a shortage of gas or other interruption of the supply. The necessity for a constant attendant, however, still remains.

(c)—Natural gas, when used in an internal combustion engine to drive a power pump, makes one of the best powers for this service, as the fuel cost is usually the least and mechanical efficiency of equipment is relatively high. The chief disadvantages are that frequent attention is required, although far less than steam, and such plants cannot be operated automatically without serious complications, although it is not only possible, but entirely practicable, to make the pump operate automatically as required by keeping the engine running continually. Whenever gas engines are used it is good policy to have gasoline attachments already on the engine, or so arranged that the engine could be operated on gasoline or other liquid fuel on very short notice.

(d)—Gasoline or other distillate when used in an engine it to be recommended when gas or electricity is not available and where the amount of water to be pumped is small, as the fuel cost is usually high. The advantage of this power is that, as a usual thing, the pumping unit can be started and operated at full capacity in a few minutes; ten minutes being a fair average. The objections are much the same as previously stated, for natural gas, but gasoline has the additional disadvantages due to hauling and storage, and dangers of explosions in or near the building.

(e)—Crude oil engines are rapidly being perfected and placed on the market which materially reduce the fuel cost, but require a little more time to start up than either the gas or gasoline engine.

(f)—Electricity is very nearly the ideal power for this service, provided that an attractive rate can be obtained and the service is reliable for 24 hours each day. The advantages are as follows: 1.—Always ready. 2.—Little or no attention required. 3.—Can be made practically noiseless. 4.—Can be used automatically.

A combination of any of the above powers may be used to advantage, depending upon the demands of the particular case.

(7)—Accessibility by the attendant in charge materially affects the selection of equipment and cost of operation. If the amount of water to be pumped is only moderate, the plant difficult of access, and electricity is available and it is desirable to keep cost of attention to a minimum, the plant should be made as nearly automatic as possible.

Third.—The third class of service is where the regular line pressure is sufficient for domestic consumption, but insufficient for proper fire protection to fulfill the requirements of the water company's charter. The method of treatment, however, would be so nearly the same as a second class that no additional suggestion will be given for this class.

Location of Booster Station.

The location of the booster station depends entirely on local conditions. All things being equal it should be located at the main reservoir from which the supply is taken. It is also preferable to have the pump so located that water will flow to it by gravity from the main reservoir. This insures the pump being primed at all times and eliminates the danger of getting air into the line. When the section to be supplied is so located that it is inadvisable to locate the booster pump at the reservoir, it should be located on a prominent main at a level which will positively assure a good supply on the level of pump intake. A large vacuum chamber as well as an air chamber should be used on reciprocating pumps, and a large air chamber would show good results even with a centrifugal or rotary pump.

In locating the booster plant, attention should be given to the discharge. It is always preferable to use an independent line from pump to booster reservoir. Pulsations and noises are easily felt on lines from which service is given. Pulsations can be reduced very materially by the use of a large air chamber, depending entirely on the type and capacity of the pump and the velocity of water in the line. Greater efficiency can be obtained from this air chamber if air can be supplied to the chamber to increase the relative proportion of air to water. Noises can be reduced by the use of special gaskets or lead nipples. In some very bad cases it can be cured by using a short section of hose in the discharge between the pumps and the discharge main. In both of these respects the advantage of using an elevated tank or standpipe or hydro-pneumatic pressure tank near the pump is very evident.

Automatic Control.

Since the cost of attendance is one of the chief items of operating expense in a plant, it is very desirable to reduce this expense to a minimum. If an attendant is required all the time that the pump is in operation, it is general good practice to install equipment of large capacity to reduce this item of expense. This means, however, larger mains and larger storage capacity. It would, therefore, seem desirable to keep line and reservoir cost down by pumping much of the day at a lower rate per hour, leaving only enough reserve to take care of ordinary increase in consumption or falling-off of pump capacity and leave ample time for ordinary repairs. To do this and still keep down the cost of attendance requires apparatus as nearly automatic as possible.

With steam equipment, an attendant is necessary on account of the use of boilers, but if steam is taken from some other source so that the pump is the only part requiring attention, then it should be the aim to provide a reliable source of lubrication, and control the speed of the pump automatically. The simplest control is by a pressure regulator, in the line where the difference between starting and stopping pressures is fully 10 per cent. of the stopping pressure, exclusive of the friction head. Where the line is a long one and the pump comes up to speed very rapidly, it will be noticed that the pressure required to accelerate the water in the line from its state of rest to its regular velocity, momentarily runs the pressure far above the maximum or stopping

pressure of the system. Ordinarily this would cause the automatic control to act and stop the pump; this pressure being only temporary the pump would again start and the result would be a rapid alternation of stops and starts. This can be overcome by the use of a tank of about 50 gals. capacity, to which pressure connection is attached. This connection should be made from discharge main to tank, so that the rate of flow from one to the other would be very small, namely 1 or 2 gals. per minute; then with sufficient air compressed in the top of the tank, so that it is ordinarily half full of water, it will be noticed that the pressure is very slow to respond to changes in the main line pressure and the temporary pressure due to starting is passed, and normal is restored before the tank shows any appreciable change.

Where the increase of pressure due to accelerating water in line is high enough to endanger the pump or other equipment, a relief or safety valve should be installed to take care of the excessive pressure.

Where the difference in pressure between starting and stopping is less than 10 per cent., the construction of most regulators is unreliable, due to back lash and lost motion in the springs and other mechanisms. In such cases an artificial head can be produced which, if the flow of water from pump was constant, could cause sufficient difference in pressure to operate the controlling mechanism with 2½ per cent. of the shutting-off pressure. If this were carried out by the use of the tank, described above, and the introduction of sufficient friction in the discharge of pump to the discharge main, it would, with the regular line friction, make the necessary difference required. This plan could not be used successfully with a centrifugal pump on account of the varying capacity of the pump under different considerations. In any case, the power required for pumping would be increased by approximately the same amount as the increased pressure; still this amount would be very small compared with the saving affected.

The automatic control of steam pumps by float from surface of water in reservoir is so complicated that circumstances would seldom justify it.

Electric pumps are by all means the easiest to operate automatically, first, because an electric pump can be provided to operate continuously with practically no attention; and, second, because electricity can be transmitted so easily. Stopping and starting can be easily performed by the rise and fall of water in a reservoir several miles away by means of a float and solenoid switches.

Pressure control is, however, always preferable, as the controlling apparatus is then under the same roof with the pump and motor and the danger from ice, storms, etc., which exist with floats, chains, etc., is eliminated.

Gas or gasoline engine automatic control is difficult, owing chiefly to the fact that most engines have to be started by some external power. This is difficult to accomplish from a remote point. Partial control may be secured by connecting up the ignition circuit of the engine with a pressure regulation or with a float switch. Then the engine is stopped when the reservoir is filled, but can not be started again except by an attendant. In this case a magneto should be used instead of batteries, since when the pressure falls to the starting point, it might short-circuit the batteries and run them down.

LARGE ELECTRIC WINDING ENGINE.

WHAT is said to be the largest electric winding engine in the United States is about to be erected at the colliery of the Christopher Coal Mining Co., Illinois. The engine works on the Ilgner system, and is of the double-drum type, having 7 ft. drums. Wire hoisting rope 1⅜ in. diameter is used. The equipment is being built to make 1,000 trips from a 600 ft. depth in seven hours. The cycle arranged calls for 6 seconds acceleration, 9 seconds at full speed, 6 seconds for retaration, and 4 seconds loading and dumping, which corresponds to a maximum rope speed of 2,400 ft. per minute. An 1,150 horse-power, 550-volt, direct-current motor drives the engine, and is direct connected to the drum shaft by a flexible coupling. The motor is designed especially for winding service, and has large overload capacity. Power will be supplied to the motor by a fly-wheel motor generator set, consisting of a 650 horse-power, 2,300-volt induction motor, an 880-kilowatt, 550-volt generator, a 17-kilowatt, 125-volt exciter, and a 22,600 lb. fly-wheel. This unit operates at 600 revolutions per minute.

OIL IMMERSED CIRCUIT BREAKERS.

AN oil-immersed circuit breaker should interrupt an electrical circuit without producing abnormal disturbances in that circuit. In addition to this very important function, the circuit-interrupting device must assist in dissipating the stored electro-magnetic energy of the system connected to it. This can be readily appreciated when we consider that any electrical circuit will have more or less inductance and capacity in addition to its resistance. Hence every electrical circuit will have more or less stored energy which must be dissipated when that circuit is interrupted. This dissipation takes place either at the point of interruption or in the circuit itself, as a result of oscillations. When dissipated at the point of circuit interruption, it is manifested principally as heat and chemical energy. Thus, it may be seen that, when systems are short-circuited, and the circuit-interrupting devices are opened and closed repeatedly upon this short-circuit, the medium surrounding the contacts of these devices becomes heated. If this medium be oil, it is very likely that the flash-point of the oil may soon be reached, and this will be followed by its ignition. This action will result in an increase of the internal stress in the oil vessels, and may result is an explosion if the device is operated while this condition exists.

CONDENSERS.

IN dealing with condensers, in a paper read before the Institute of Marine Engineers, Mr. W. Veysey Lang, makes the following remarks:—"As far as I have had cause to investigate, I have generally found sufficient cooling surface in the ordinary main condenser, and size in the air and circulating pump diameters, to give a moderate vacuum; but in several cases that have come under my notice, the vacuum was by no means satisfactory. With one installation in particular, of 1,600 indicated horse-power, the actual surface was on the excess side and the air and circulating pumps, although rather small, were of sufficient capacity to deal with the steam under normal conditions, yet a vacuum was never obtainable at first, of over 23—23½ in. at sea. This was a three-flow condenser. Eventually by trial and experiment, consisting of taking out tubes to admit of a better steam circulation, fitting of steam baffles, and most effective of all, the diversion of a portion of the initial circulating water from the first to the third flow by a 4 in. pipe from the bottom to the top of one water end, the vacuum is now easily maintained at 25—26 in."

As a result of investigations undertaken by the Commissioner of Conservation, it has been ascertained that there are 1,016,521 horse-power developed from water power in Canada.

Current Topics

Acetylene Gas. — Although acetylene gas was discovered in 1836, it was not until 1892 that its commercial development was made possible by Willson, who discovered a method of producing calcium carbide in large quantities. The application of acetylene to heating and power has been very recent indeed, and the use of acetylene and oxygen in the blow-pipe has produced almost the highest temperature known to chemistry —a temperature approximating that of the electric arc, probably above 6,000 deg. Fah. Through this means, welding has been successfully accomplished and several other important industrial applications have been found. Large steel bridge girders can thus be cut apart with ease.

Burst Boiler Tube.—An examination of a burst boiler tube, which was weldless, showed it to be composed of very mild steel. Hard scale, scraped off the outside of the tube near the fracture, contained a high percentage of sulphide of iron (S = 1.65 per cent.). This sulphur is considered to have been reduced from the sulphurous gases due to combustion; and as this reduction cannot take place below 750 deg. Fah., it is safely thought that the portion of the tube where the scale was found had been kept above this temperature for some time. Micro-sections were made of several parts of the tube, which proved that the metal consisted of martensite. The only method of producing martensite is by heating steel to a temperature 1,090 deg. Fah. and above and suddenly lowering it. This observation appears to point to the fact that at the time of the explosion the tube had been heated above 1,090 deg. Fah.

Electric Railway Operation.—In a paper read before the American Institute of Electrical Engineers dealing with economies in electric railway operation, the selection of improper gear ratios is pointed out as a source of enormous loss to the operating and manufacturing companies. Few people who have not made a study of the subject realize its importance, and there are many motors in service which are so geared as to result in a continual loss to the operating company. The large American corporations have been realizing more and more in recent years the disadvantages of high-speed gearing and some of them are now making wholesale changes in this respect, reducing the maximum speeds and making savings of 5 per cent. to 12 per cent. in power consumption, besides greatly reducing the temperature of the motors.

Corrosion Tests of Pipes. — Results have been recently published of cold-water corrosion tests made in 1 in. pipes 30 ft. long, the temperature range being 50-70 deg. Fah. The test lasted for nine days. Hot water tests at 125-135 deg. Fah. were also made in pipes 5 ft. long with similar fittings, the tests lasting three days. Mechanically filtered water was found to be much more corrosive than the original supply; water from a slow sand filter usually slightly more corrosive; a pond supply, showing virtually the same alkalinity, very corrosive; as was also a driven well supply. Treatment with lime decreased slightly the corrosive action, while soda had little effect. Heat, both in iron and galvanized iron pipes, greatly increased corrosive action. Alkalinity with lime increased corrosion with cold, but had a reverse action with hot water. In every case galvanized iron pipes showed less action than iron pipes, defective coating or thread cutting no doubt being to blame. Dissolved oxygen greatly assisted corrosion, the oxygen in the water being greatly diminished after the test. The removal of small amounts of protective organic matter was held responsible for the increased corrosion of filtered waters.

Power Station Working. — With an economizer of ample size, states Mr. J. W. Jackson in a paper on "Power Station Working," it is now possible to obtain overall boiler and economizer efficiencies of as high a figure as 85 per cent. Economizers are now so robust that they are looked upon as quite automatic and often left to themselves for more or less long periods. At the same time. close attention to economizers is well repaid in prolonging the life of the metal as well as keeping the economizer casing air-tight. By looking after air leaks in a boiler and economizer combined in regular commercial service, it is possible to reduce heat losses going up the chimney to about 10 per cent., whereas a neglect of precautions will allow these losses to rise to as much as 30 per cent. and still afford little evidence of what is going on by observation of the color, which, of course, means the temperature of the flame in the furnace. The economizer of the future, Mr. Jackson considers, is undoubtedly one built on what might be termed the "contraflo" principle, wherein the water is caused to circulate through so many sections in series. Experiments have already been carried out on these lines with beneficial results.

Generation of Steam.—It has recently been maintained by Mr. George Wilkinson, the chief electrical engineer of the Harrogate Electricity Works, that the generation of steam calls for a radical change in present day practice. He maintains that we have too long been content to use boiler plant, furnishing an average of from 2 lb. to 3 lb. of steam per hour per square foot of heating surface. Such practice involves the use of enormous boiler plants out of all proportion to the size of the generating plants. Reference to the plans of modern works equipped with from 10,000 to 20,000 kilowatt units of power show a separate boiler-house for each generating plant. These boiler-houses are built end-on to the power-house, and impose a heavy capital cost for boilers, buildings, flues and chimneys. They also involve heavy losses in boiler, steam pipe and flue radiation. The solution of these difficulties, Mr. Wilkinson considers, appears to lie in the introduction of gas firing, by means of flameless surface combustion on the lines first discovered by Sir Humphrey Davy, and more recently developed and set out by Professor Bone in his lectures before the Royal Institution of Great Britain in 1911. So far as investigations have gone at present, it is shown that an evaporative duty from boilers exceeding 20 lb. of steam per square foot of heating surface, can easily be obtained with a thermal efficiency corresponding to the transmission to the water in the boiler of nearly 95 per cent. of the energy represented by the net calorific value of the gas.

Screw Connections.—All screw connections exposed to considerable heat or to moisture are liable to become very difficult to undo, if proper precautions are not taken. The unions on the generator of a steam car or the unions on the exhaust pipe of a petrol car are, remarks the Autocar, good illustrations of this. The brake pins and nuts, the nuts on spring clips, etc., are also very likely to become rusted on. Whenever any such connection is removed, a little pure graphite mixed with oil to a paste of the consistency of cream should be applied to the threads. The nut or union can then be unscrewed without difficulty, as although the oil may be burned off, the graphite never leaves the metal, so the threads cannot seize nor oxidise and give trouble. Why, adds our contemporary, makers do not adopt this system with new cars, is not easily understood, as it costs practically nothing. Those who have struggled with nuts firmly rusted on somewhere underneath the car—such as an axle spring clip—will appreciate this point.

Saskatoon, Sask. — The Armstrong Manufacturing Co., of Waterloo, Iowa, manufacturers of well-drilling machinery and gasoline engines will locate a factory and warehouse here some time in the near future.

INCREASING STEAMING CAPACITIES OF BOILERS.

THE United States Bureau of Mines makes the statement in a bulletin just issued that the present steaming capacities of boilers can be tripled or quadrupled by forcing over the heating surfaces three or four times the weight of gases now passed over them.

"With well-designed mechanical-draft apparatus this greater weight of gases can be forced through the boilers at small operating cost. It is possible to increase the capacity of many existing boilers in this way without reducing their efficiency much; in fact, by proper arrangement of the heating surfaces, the efficiency can be made higher than the present rating. The efficiency of any boiler can be increased by arranging its heating surfaces in series with respect to the path of hot gases. New boilers of high efficiency can be constructed by making the cross section of the gas passages small in comparison with the length."

These statements are contained in Bulletin 18, the "Transmission of Heat into Steam Boilers," the authors being Henry Kreisinger and Walter T. Ray. The investigation of the transmission of heat in steam boilers is one of several researches now being carried on by the Bureau of Mines that have for their object the testing of methods by which the mineral fuels in this country may be used more efficiently. A better understanding of the laws governing heat transmission into boilers will result in the design of more efficient boilers, and more efficient boilers will reduce waste in the use of fuel.

Memo From Bulletin.

The bulletin contains the following:—

"Nearly a hundred years of practical investigation of boiler and furnace problems has resulted in little advance. Perhaps, the main reason why many of the investigations failed to bring about progress was, that boiler and furnace were considered a unit and were investigated together. Various combinations of boilers and furnaces have been built and tested without thoughtful planning. Many of the published results of such tests confuse the performance of the boiler and the furnace in such a way that it is difficult, if not impossible, to tell which of the two should be blamed or praised for the poor or good results obtained from the combined apparatus. Evidently, many persons have thought that the combined efficiency could be greatly increased by some mysterious manipulation.

The principles governing the combustion of fuel in boiler furnaces and the absorption of heat by boilers have been little understood. The dogmas that the area of the grate should have a certain ratio to the area of the heating surface, and that it takes 10 square feet of heating surface to make one boiler horsepower, seemingly had become so thoroughly fixed in the mind that they were hardly ever questioned. It is only within the last decade that a few engineers have broken away from the old rule of thumb methods and have begun to investigate the functions of the boiler and furnace separately. Their studies seem to mark the beginning of advance in steam-generating apparatus.

The boiler is the metallic vessel that contains water and steam and absorbs heat; consequently it should be studied as a heat absorber.

The furnace is that part of the steam-generating apparatus in which the potential energy of the coal is changed into heat; consequently it should be studied as a heat generator."

Copies of this bulletin may be obtained by writing to the Director of the Bureau of Mines, Washington, D. C.

SMOKE PRECIPITATION BY ELECTRICITY.

A DEVELOPMENT is being made in the United States of a process for electrically precipitating the suspended matter from smelter smoke and fumes, and the dust from rotary kilns in cement works. The general principle is not new, and has been applied successfully in laboratory work by different investigators. The first experiment on a working scale was at the Hercules powder works, where sulphuric acid separated as a dense white cloud of suspended particles. Being so fine it was extremely difficult to remove by filtration, but was easily precipitated by electric current. It was next tried in treating the mists escaping from boiling sulphuric acid used to dissolve silver. At the Balakala works, the gases from pyrites-roasters and matte-roasters are treated at the rate of 250,000 cubic feet of gas per minute. The material is a mixture of solid dust and fume, with liquid sulphuric acid and the gases are highly charged with water vapor, which dilutes the acid and produces a muddy deposit. The gases are treated in flues of sheet lead.

The plant of the Riverside Portland Cement Co., was made the basis of great complaints by fruit growers on account of the fine dust thrown out by the rotary kilns and carried to great distances over the orchards. A plant was installed to treat the product of one kiln—50,000 cubic feet of gas per minute—and the results were so satisfactory that the other nine kilns have been equipped in the same way. The process now being applied also to the removal of dust from blast-furnace gas and producer gas, was developed in the chemistry department of the University of California by Mr. F. G. Cottrell, but the university could not undertake its commercial exploitation, therefore, a special board or "corporation" has been organized to do this. This board will operate like any business concern, except that instead of paying dividends to the stockholders all net profits will be devoted to scientific research.

ROPE TRANSMISSION.

IN a paper on "The Transmission of Power by Ropes," read by Mr. Edwin Kenyon before the Canadian Society of Civil Engineers, it was stated that, all things being equal, the durability of cotton ropes may be gauged by sectional area, and the most economical diameters range from 1½ in. to 1¾ in. A remarkable case of longevity has occurred in the case of twenty-four cotton ropes 1¾ in. diameter, employed to transmit 820 horse-power direct from an engine fly-wheel 28 ft. diameter in a Lancashire cotton mill. They were fixed in September, 1878, and have been running from then till now, a period of over thirty three years. The lives of other cotton ropes under similar conditions have extended over periods little short of this, while others fixed from eleven to fifteen years ago and working without cessation, week-ends excepted, are still doing good service. Such longevity leads to the conclusion that "fatigue" due to constant activity does not readily manifest itself in well-made cotton driving ropes. Their quick recovery from driving strain is suggested as the cause, seeing that they pull down on the working side but bulge out to their normal diameter immediately they pass to the trailing or slack side of the pulleys.

A LARGE STEAM TUBBINE

THERE has recently been delivered to the Rheinisch-Westfalischen electric generating station at Essen, by its makers, Escher, Wyss and Co., of Zurich, one of the largest steam turbines contained in one casing that has, up to the present time, been built. This turbine has been designed to develop 22,500 effective horse-power under normal continuous working, at a speed of 1,000 revolutions per minute, the initial steam pressure being 150 lb. per square inch above atmosphere and the steam temperature 572 deg. Fah. before stop valve, and exhausting to a vacuum of 27½ in. It is only possible to obtain this vacuum, as the temperature of the circulating water for the condensing plant is comparatively high, the water being dealt with in a cooling tower only. This turbine can, it is stated, develop 28,000

horse-power under continuous working, and up to 30,000 horse-power for short periods.

The design is of the usual "Zoelly" type, of which Escher, Wyss & Co. have already constructed well over 225; the aggregate capacity of which approximates half a million horse-power. The turbine rotor consists of fourteen runner wheels, and the total weight of rotor including shaft is 26 tons.

The generator rotor which is of the Siemens-Schuckert type, is connected to the turbine shaft by means of a rigid coupling, and weighs 60 tons. The generator and turbine rotors are supported by four bearings, which are lubricated by about 130 gallons of oil per minute under pressure. When starting up the turbine, the oil pressure is obtained by a small steam turbine driven centrifugal oil pump, but as soon as the turbine has attained its normal speed, a cogged-wheel pump, driven from the main shaft, produces the desired pressure, and the centrifugal pump is then shut down. The oil flows from the bearing to an oil tank contained in the bed-plate of the turbine, where it is cooled by means of coils, through which water flows. It is then pumped back to the bearings by the cogged-wheel pump, and continues the cycle thus described. Only a very small quantity is required from time to time to make up for waste.

The exhaust steam is led through a pipe of 8 ft. diameter to the surface condensing plant situated in the basement of the power-house and immediately below the turbine. A separate pump delivers the condensed steam into a tank, from whence the boilers are fed by means of feed pumps. This large turbine is said, owing to its simple design, to require little more attendance than much smaller units.

LOSS OF DUCTILITY IN BOILER TUBES.

By a Chief Inspector.

IN the examination of boilers and other vessels operated under steam pressure, the inspector often meets conditions which, to him, at least, are unexpected and peculiar; but while they may be new to him, generally, on conferring with other inspectors, he will learn of similar instances. The present incident, with its tests showing the nature of the trouble, may be of assistance to some one in clearing up such a difficulty.

A Case in Point.

The agent for a large manufacturing concern desired an examination of one of his boilers, which were of the water-tube type, and all duplicates. They had been in service but a comparatively short time. He requested this inspection not because of any trouble, but on general principles, as several months had elapsed since the last regular examination. The writer responded to this request, finding one of the boilers properly prepared for inspection. No ordinary defects were found. The boiler was clean and free from scale in all its tubes and drums. The tubes were of full thickness, and under the hammer test not the slightest indication of anything defective was conveyed to the examiner. He noted, however, a peculiar appearance in those tubes which were accessible and directly exposed to the fire. Touched with a fine file the metal was bright and its appearance was perfectly normal. The unusual color of the tubes, however, disturbed him very much, and he requested that some of them be removed for testing; since while they might prove soft and ductile he was of the opinion that they were dangerously brittle, and feared from the general arrangement of the fire-room that loss of life would follow the failure of a tube at the high pressure carried.

He held this view notwithstanding the fact that these boilers were designed with a good factor of safety for the pressure carried, because he considered the danger of personal injuries greater than that of a property loss. The mill agent took up the question of testing the tubes at once. The first blow struck with a chisel in cutting off one of them close to the drum caused the tube to break. Every tube was then removed and test specimens one inch wide cut from each. All were found to be practically as brittle as the first, and showed an entire absence of ductility. It was felt that if they had been continued in service, a shock or even the vibrations of the engine would have been sufficient to have fractured one or more of them, and the reaction might well have caused the breaking of others.

Chemical Analysis.

Examples of four of these tubes were sent for chemical analysis, the result of which is given in the following table:

TABLE I.

	Per Cent.			
	No. 1	No. 2	No. 3	No. 4
Carbon	.06	.06	.06	.06
Manganese ...	.02	.02	.02	.02
Phosphorus ...	.079	.073	.065	.073
Sulphur	.020	.026	.024	.020
Silicon	.154	.159	.143	.154

Compared with the requirements for fire-box steel boiler plate the low percentage of carbon and manganese with high phosphorus will be at once noted, and will indicate why the tubes were so deficient in ductility.

Another Experience.

At about this same time a similar change was found to have occurred in the tube cap bolts of another type of water-tube boiler, from the same maker but belonging to another firm. These bolts, which were not exposed either to the direct action of the fire or to so high a pressure as in the first case, were found by the inspector to be so brittle that on sounding them with his light hammer many of them broke as if they had been glass rods. The chemical analysis of these bolts was very similar to that of the tubes mentioned above, though differing from it to a slight extent. The conclusion is obvious that the stock in both tubes and bolts was of a very inferior quality and ought never to have been used in any place exposed to high temperatures or to strains due to pressure. A new tube and several bolts from the same stock as those removed were tested physically and showed good ductility, but analysis proved that the material was no better than that which had been rejected for its extreme brittleness.

It has long been a dream of the writer that all material used for boiler work should be plainly marked, the marks to be uniform with all manufacturers and to indicate the quality of the material. These could be placed upon the head of a bolt in forging at slight expense, and in welded tubes could be made at the time of welding. Solid drawn tubes present, of course, a slightly different problem, but that process itself would perhaps be a guarantee of a better quality of material than would be used for welding.—The Locomotive.

DURABILITY OF BALL BEARINGS.

IN our September issue, we published a short article relative to the remarkable service record of ball bearings in one of the journal boxes of an electric car on the Atlantic City and Shore Railroad. Further data concerning these is now available, from which it appears that the car in question has not only one, but all its eight main journals equipped with ball bearings, comprising a total of 16, or two per journal, one on each side of the pedestal jaws. These ball bearings were put in service at the same time in October, 1908, and as none of them showed any appreciable wear it was sufficient to make a detailed examination of a single pair. The car weighs 72,000 lbs. empty, and when packed with people on holidays has occasionally carried as many as 110 passengers; its total weight being then about 90,000 lbs. Under favorable conditions of voltage and wind, it attains a speed of 50 m.p.h. on the level track.

Each ball bearing contains eight 1½ in. balls running in specially hardened grooved races or rings of high-grade steel. A point of special importance is

the fact that the balls are separated by a hard solid bronze cage, which is practically "unsmashable," so that if any two balls tend to come together owing to jerks causing necessarily irregular temporary deformation in the metal, the separator is able to withstand the squeezing action. This successful application of ball bearings to railway work is due to Mr. Henry Hess, an American, who invited Mr. Cyril J. Hopkins—an English electrical engineer, experienced in American railway conditions—to undertake the task of application. Mr. Hopkins was responsible for the details of design, both in the ball bearings and in the journal boxes, as well as for the selection of a suitable size of bearing, which secured success.

Some 25 tramway cars, comprising ordinary electric, battery, and gasoline-electric types, have now been in successful operation with similar ball bearings on the main journals in the United States, in Rochester, Philadelphia, and New York for one to two years or more. Installations have also been made more recently in other cities. Such bearings are still more extensively applied to railway motors, including those used in mines, and between 1,000 and 2,000 bearings are now in use in the United States. The first sets were put in service on motors working in a coal mine in Framlingham, Illinois, in August, 1908, just over four years ago.

TEXTILE MILL DRIVING.

A HIGHLY practical arrangement was made by the Textile Institute for its recent congress. Four authors had been invited to discuss the driving of textile mills from the respective points of view of the steam engine, the Diesel engine, the gas engine, and the electric motor. To enable comparable figures to appear in the papers, the authors had met and agreed upon certain bases of comparison, and the result was a series of entertaining papers.

Mr. J. F. Crowley presented a very good case for electricity. He said that over 7,000 motors had been sold in England for loom driving. The case for electrical driving did not depend merely on a saving in transmission loss. Steadiness of drive and the advantages accruing from the adoption of individual drive were important factors. Then there were flexibility, lighter and cheaper buildings, less floor space, improved lighting, and so forth. It was difficult to convince mill owners that serious fluctuations in speed occur in ordinary mechanical drives. Mr. Woodhouse had made tests on a mule counter-shaft, the mule being the worst offender in the textile mill, which showed that with mechanical drive the maximum speed range was 25 per cent. of the mean speed in the case of mechanical drive. This was reduced to 17 per cent. for an individual D. C. electric motor, and to 6 per cent. for an A. C. motor. The mule in a mechanically operated mill affected the running of every machine connected with the shafting from which the mules were operated. With electrical driving this trouble disappeared.

Constant Speed Desirable.

It was important to remember that constant speed should be maintained during the actual spinning portion of the mule cycle, and that a given variation in speed would be more serious with a grouped drive than for an individual drive, since, in the former case, the speed fluctuations would result from the variation in load of the mule itself, and would, therefore, follow the cycle of operations in the mule. Individually driven mules gave a 5 per cent. increased production over group or mechanically driven machines. For the driving of ring-spinning machines, electricity has peculiar advantages. In the worsted trade, ring v. mule spinning was a matter of argument, but the ring frame had been aided by individual electric drive with automatic speed control, and as much as 18 per cent. in time had been saved by this method against electrical driving alone. A ring doubling frame tested on the Lancashire Electric Power Co.'s mains showed a maximum speed range of 6 per cent. of its mean speed when mechanically driven, and of 0.5 per cent. when electrically driven. By adopting electric driving, loom speeds could be increased. Speed fluctuations grew worse as the distance from the engine increased, and in a Yorkshire mill a 3 per cent. variation in engine speed was magnified to one of 20 per cent. on the line shafting.

Test Data.

Tests taken some time ago to convince a doubting manufacturer of the advantages of electrical driving showed that the loom speeds could be raised 9 per cent. without any increase in breakage, the material improved in quality, and the production increased from 15 to 20 per cent. Increased production was of much importance. From Board of Trade returns he could show that a 10 per cent. increase in production in one case resulted in a 30 per cent. increase in profits. Motors for textile work had to be specially designed. They must be well protected from dust and "fly." Their rating must be liberal, as the load is usually continuous. Their efficiency must be high over a wide range of load. Since the starting torque for loom motors was two and a half times normal and for spinning motors twice normal, the starting torque must be high. Their speed regulation from no load to full load must be small as well as over the usual variations in voltage.

STRENGTH OF OXY-ACETYLENE WELDS.

THE exact strength of a weld made by the oxy-acetylene process is always something of a mystery to boiler makers, and the average boiler maker is usually very cautious in subjecting an oxy-acetylene weld to excessive stresses. At the Twentieth Annual Convention of the International Railroad Master Blacksmiths, held in Chicago in August, Mr. C. J. Fackler, of the American Car & Foundry Co., Jeffersonville, Ind., described some of the tests that he had made on the strength of oxy-acetylene welding, and the results of these tests will undoubtedly be of interest to boiler makers. The Davis-Bournville welding system was used, and five welds were made in 3/8-inch and 5/8-inch round mild steel rods 18 inches long. These were bent on the anvil in the shape of a coil spring.

The rods were given rough treatment, as it was the object to break them if it could possibly be done. There were three fractures in the 5/8-inch piece and one in the 3/8-inch piece, which were due to carelessness on the part of the welder and not on account of the system. Two pieces of 2-inch by 2-inch mild steel were welded together, and after being brought up to a high heat the piece was drawn down to one-fourth of its original size. A slight fracture was found in one corner. The piece was then bent back and forth in an attempt to break it, but no fracture occurred. Mr. Fackler, therefore, expressed his conviction that a weld can be made on 2-inch material, but that a good operator should do the work.

The usual run of work which is used in the shop with which he is connected is on light stock, such as 3-16 inch plates, making welds from 6 inches to 8 feet in length. If the work is placed in the hands of an experienced welder it has repeatedly been demonstrated that reliable welds can be obtained.

Natural Gas as a Fuel.—As a fuel, natural gas is burned in almost exactly the same way and with almost the same appliances as manufactured gas. It may be used in the ordinary gas range, hot plate, water heater, or other gas burning appliances, the only change necessary being, that because of the higher pressure, the gas orifices should be smaller, and because of the higher heating value, less gas is necessary to produce the same results. The application of natural gas to coal burning installations of all kinds is very simple and, as a rule, very efficient.

Installation and Operation of the Small Power Plant*

By Professor E. V. Lallier

We are so much accustomed to associate economy and efficiency requirements with large installations of power generation mechanism only, that those of lesser proportions go for the most part unheeded. That there is corresponding achievement awaiting those who own and operate small power plants is plainly and pointedly indicated in the broad treatment accorded the subject by the writer.

IN this, the first of another series of meetings for the purpose of discussing various phases of the power plant, particularly those relative to its proper installation and operation, your committee has designated rather a broad subject for me to cover. In fact, it will manifestly be impossible, and I will not endeavor to treat of the details of the steam plant this evening, but merely to trace an outline of its most important features and their inter-relations in such a manner that when we discuss the separate items at some later date we will have no difficulty in recalling their connection one to another or to the plant as a whole; not of large, but moderate-sized plants. I believe that we should broadly consider the steam plant under two heads; we should look at it from the physical and the business point of view.

Efficiency and Economy.

Let me ask then, what do we require from the plant? You answer efficiency and economy. Good; to obtain the first, we must have a satisfactory physical condition; that is, the material and apparatus must be of good, if not the best of quality. It must be installed to advantage, that is, convenient for operation, repair, and replacement. It must be handled by able and competent men, whose interest in its welfare is rewarded by something more substantial than the mere pride in good work well done.

From the economical side, the plant should steadily produce the best results of which it is capable with a reasonable expense. It should not be hampered by shortsighted finance, but on the other hand it should not be carelessly granted expenditures, except when careful consideration has shown that such expenditures may be expected, with a reasonable degree of certainty, to produce results.

To do these things requires, first, a competent engineer in charge, one who is not only a thoroughly practical man but one theoretically proficient, capable of reasoning carefully, and able to apply results of this reasoning to the plant in his charge. He should also be a business man, that is to say, one familiar with costs; capable of analyzing the various branches of his department, and their relation to each other; to keep records of his plant as though it were a business of his own; a man quick to perceive and plan improvements, and able to maintain the plant in the best of condition.

Status of Operators.

Perhaps some of our friends may say, "Why, you are describing the ideal engineer." Perhaps I am, but let me tell you that there are many such right in this city, and they are not all in charge of large plants, either. The engineers' associations of this city, and particularly those of the N.A.S.E., have for years been conducting an educational campaign in their meeting rooms, by means of lectures delivered by their own members, college instructors, specialists in various lines, and instruction in the use of intrument and apparatus at the service of the members. The modern stationary engineer, constantly in his daily work applying rules he has been taught in his meeting room, has been gradually and surely becoming in many cases competent to discharge practically all of the duties for which it was formerly thought necessary to call in the services of the professional consulting engineer. For example, we need consider only the work of the test committee, and right here, I wish in passing to call your attention to two curious phases of human nature; in the one case an owner will employ an engineer without investigation, any further than a few conventional questions and turn him loose in the plant without really being in any way informed as to the applicant's ability to discharge the duties required.

Consideration for the Operator.

Again, after careful thought an engineer is engaged, and put in charge. But he has no opportunity to ascertain the prices paid for material. His advice as to the quality is not regarded. The cost price is quoted (often to some office man totally unacquainted with engineering needs) and this governs the purchase. No change or alteration, however beneficial in the future, is permitted on account of the first cost, and yet he is held responsible for the efficiency of the plant. What business man engaging a manager would expect him to work under these conditions, or who, having money to invest would not exercise care to invest in such manner that it would yield a profit, and at the same time conserve the principal?

The plant owner is investing money in the plant, but it is the duty of the engineer to handle the plant to advantage, and to see that the proper means for so doing are provided, and we will therefore now consider a few points covering the plant itself.

A Plant Should Have Proper Room.

As a beginning we should have room to work. Too many plants appear to have been installed as an afterthought, as though after the building was completed some corner useless for other purposes was selected as the place to install the boilers, engines, pumps and auxiliary apparatus required. What is the result when later on the inevitable replacement, say, of a boiler tube, or pump rod, becomes necessary? Instead of this meaning an hour or two of work, perhaps by the engineer himself, it requires moving the pump, and consequently breaking the connections, and even as I have known, to necessitate the tearing down of a brick wall at a considerable expense to enable a tube to be removed. Head room should be provided. I know of many boilers so close to the ceiling that any repairs to the pipes or valves above them cost at least 100 per cent. more than should be the case; all on account of the difficulty of working in the contracted space. I know of at least one plant where internal inspection of the boiler requires the engineer to enter through an opening in the sidewalk. Does this tend to encourage as frequent inspection of the boilers' condition as should be made?

Good ventilation is necessary, and plenty of light. These are not only aids to health, but a light plant is kept clean and a clean plant is a well kept one. Sufficient coal storage capacity is to be desired, and it should be accessible directly from the boiler rooms. If so placed that one man's time is required to wheel coal from the bunkers to the fireroom, and a comparatively inexpensive change would eliminate this expense, we should consider that the amount saved during one year would pay for many tons of coal, besides paying for the change, while the saving will continue year after year.

*Abstract of a lecture delivered recently to the General Committee of the Ten Combined Associations of Manhattan and the Bronx.

Store Room.

Another necessity is a well ordered store room. This, too, will pay for the space utilized, over and over again, in the saving of time otherwise required to look for misplaced articles, the prevention of over-buying, and conserving the condition of supplies. The engineer in charge should also, have at least a decent desk, and several shelves, even in a small plant, where he may retire to make out his records, accounts and reports. This should be placed in such a position that he may readily oversee the plant when at his desk. Again, the boiler room, while readily accessible from the engine room should be so separated by partitions (preferably glazed) that the dust from ashes, etc., cannot settle on the moving parts of engines, pumps and other machinery.

The Boilers.

The boilers should be of such size as to readily carry all normal load and have some reserve capacity. It is good policy to have an extra boiler, not only to permit of the usual cleaning, etc., without interference with the routine of the plant, but so that in case of repairs or breakdown the regular operation of the plant will not be interrupted. They should be accessible on all sides, and the stack should be of such size, height, and so connected, that heavy weather will not be productive of sluggish draft.

Two classes of boiler are available for power purposes; where the power load is variable, the water tube type perhaps may be preferable on account of the readiness with which they respond to an increased demand for steam, but for the smaller plant, or one with practically steady load, the fire tube boiler requiring perhaps not so constant personal supervision will be best to use. In either case, they should be carefully set to prevent radiation externally, and to obtain dry steam. If the size of the plant will permit, a superheater, or fuel economizer will be a profitable investment. Manual regulation of the draft should not be permitted, as this cannot but be irregular in its application and besides being harmful to the boiler, is wasteful of coal. With an automatic form of damper regulator the air supply is maintained nearly constant and within very close limits.

Leaky Valves.

Too much care cannot be given to the condition of the feed valve, safety valve, steam gauge and other boiler auxiliaries. This is particularly the case as regards the blow-off valves. These are usually located in a more or less difficult place to get at for frequent inspection, and a leak in one of these will in the course of a year prove an expensive matter. In one case recently brought to my attention, the valve leaked a fraction under one cu. ft. per hour. This plant was under working pressure 12 hours a day, and six days a week for 300 days per year. Assuming the leak to occur only during that period, the total per year was but a small item, you say—true, but remember this water was heated before being lost, and it required power to pump it, in short. this one small leak represented a cost of $35 per year; a sum representing interest and depreciation charges on an amount sufficient to replace several such valves.

Another case was during a boiler test, the evaporation seemed remarkably high, and yet the moisture in the steam was only average. Investigation developed the fact that a valve used for draining the feed water heater was open, and the water was flowing through to the sewer. Still, another prolific cause of waste sometimes overlooked , are leaky trap valves. Such a condition permits perhaps a small but continous flow of steam which is difficult to detect except by constant vigilance and checking up of results.

Water Scale.

The best of water will deposit solid matter in the form of scale in our boilers, to remove which, blowing down is not sufficient. Internal cleaning at certain intervals is required, and it may be of interest to note at this point, that a layer of scale of a thickness of 1-16 inch causes a loss of 20 per cent., while a scale of 1-8 inch causes a loss of 30 per cent. of the heat from the fuel. Scale, to some extent, is a neeessary evil. Too much of it is not. Do you know that if we are burning 2½ tons of coal per day at $3.50 per ton that a loss of 5 per cent. will in a year amount without interest to $134.16, a sum well worth saving.

Combustion of Fuel.

The burning of the fuel is a most important matter, for the heat losses, comparatively large in any case, may easily be increased by improper firing, and by grates and furnaces unsuited to the work. The furnace should have ample coal-burning capacity; it should be able to burn the maximum amount of fuel under favorable conditions or draft, due to weather conditions, etc. The grates must be placed at the correct distance from the boiler to care for the kind of coal used, and should have air spaces proportioned to the quality of coal.

Anthracite Coal.

For large sizes of anthracite, almost any average grate, and a fair draft will serve; but of course intelligent firing is required. The first must be kept at an even thickness and watched to see that no thin or dead spots occur. If the bed of coal is too thick, an excessive supply of oxygen passes through, causing a waste of heat; if it is too thick some of the carbon will be burnt to carbon monoxide only, instead of to carbon dioxide, and we again lose much heat. The latter condition is evidenced by the presence of flickering blue flames on the fire. With the finer sizes of anthracite, a better draft is required, and a thinner fire must be carried. This, of course, requires more attention, and more frequent cleaning.

Bituminous Coal.

It may be desirable to burn a bituminous coal, but with the ordinary methods of hand firing it is difficult to get economy without exercising care in handling the fuel. In some plants the hard and soft coals are mixed, but with varying results, largely due to the method of firing. It may, therefore, be interesting to consider for a moment the events which occur between two consecutive firings. Suppose we have a good hot bed of coke on the grates, and the fresh coal (much of it of fine size) is spread over it. The first thing the fine coal does is to choke the crevices in the coke bed through which the air supply passes, thus stopping the passage of the air needed to burn the gases produced from the fresh coal.

Proper Combustion.

Now comes the evaporation of moisture from the coal, which tends to lower the temperature of the furnace.

Following this, is the formation of water gas, which takes place when steam is brought into contact with the very hot carbon. This also absorbs heat. Now the gases thus formed would give back all the heat absorbed as described, if we could burn them, but the air being partly cut off there is not enough present for the purpose. It will do no good to open the fire door as the air entering there is cool and will not burn unless heated. After all the moisture is driven off, the distillation of the hydrocarbons begin; but a large part escapes and is wasted as we have not sufficient hot air to burn them. All this time quantities of smoke, unburned hydrocarbons, hydrogen and carbonic oxide, all fuel gases, are escaping through the stack, and soot is being deposited on the heating surfaces, to act as a neat insulator. After awhile, the fine coal is burned away, and the air begins to come through; the combustion improves; the coke bed is restored in good condition and remains so, until as it burns through in spots we have again a poor condition due to excess of air. These conditions may be avoided, if the gases are distilled slowly, if they are brought into contact with very hot air, which may be done by burning them in a hot fire brick chamber, and if they are so

handled as to produce complete combustion before coming into contact with comparatively cool surfaces, such as the shell and tubes of the boiler. The desired result may to some extent be obtained by the coking, and alternate methods of firing, also by introducing baffle wings in the combustion chamber in order that the hot surfaces may have a sort of regenerative action similar to that used in some steel making furnaces.

Automatic stokers for the gradual and regular introduction of the fuel, rocking, and other grate bars also serve to facilitate the handling of coal to the best advantage. Where the conditions will permit, the fuel economizer may be used to advantage. For example: suppose that a given boiler absorbs 70 per cent. of the heat generated, it can be shown that with the economizer absorbing 40 per cent. of the remainder the efficiency of the outfit may be increased to 80 per cent.

Pipe Coverings.

Another important factor in the plant is the proper insulation of pipes; these being of a material which readily conducts heat should certainly be covered with a non-conductor of heat except at such points as it is desired that radiation shall occur for heating or drying purposes. In one instance, a steam pipe 60 feet long was subjected to test, and the contained steam was found to contain 31 per cent. of moisture; after covering with an efficient heat insulator, this was reduced considerably.

Various materials are available for this purpose, among the best of which are hair felt, slag wool, magnesia, and asbestos, either singly or in combination with each other, or with other materials. Hair felt, while an excellent non-conductor, must be protected from actual contact with highly heated pipes to prevent it from charring. Slag wool has the advantage of being fire-proof. A mixture with asbestos as a base is largely used with good effect and is supplied in convenient form for application. Asbestos is composed of lime and magnesia 37 parts, 3 parts oxide of iron, 1 of potash, 1.4 soda, 3 alumina, 11 and a fraction of organic matter, and when mixed with some other slow conducting substance makes a good covering. Water should not be permitted to drip on the pipe covering, neither should a leak, however small, be permitted to continue, for, outside of the direct loss due to the escaping steam, a wet covering rapidly becomes a very poor non-conductor of heat.

Piping Should be Accessible.

All engine and boiler room piping should be readily accessible for inspection and repair. Where it is necessary to place pipes in walls, or under the floor level they should be run in proper ducts with covers easily removable. I have seen installations where the saving of $100 in the first installation of a plant costing several thousand, has rendered it necessary later on to remove three or four good pipes in order to repair one, which was in bad condition. The extra expense of the time, material and labor involved, would have paid the interest and depreciation on the original sum many times over without considering the consequent annoying delay.

Selection of Prime Movers.

Probably the majority of the plants in operation employ steam for the production of power, therefore the selection of a prime mover is required, and we may choose between the turbine and reciprocating forms of engine. The former is not as yet employed to any great extent in the plant of moderate size, and the choice resolves itself perhaps to one primarily between the high and the slow speed engine, and whether it shall be vertical or horizontal, simple or compound. The final choice is of course, influenced by the existing conditions as regards the available space and the character of the work to be performed.

If the output is to be entirely electrical, a direct connected unit will be the most compact and convenient form. If the load is intermittent, for example, let us say that 40 per cent. of the full load is called for during a period of six hours, nearly full load during the next four hourse, and 30% during the next two hours, then two or more engines will be installed in order that singly, or in combination, they may be capable of handling the load during the various periods. This enables us to run the plant in a more economical manner, besides proving a reserve unit for emergencies.

It may be well in selecting the type of engine to bear in mind the fact that a slow speed engine does not wear out so rapidly as one running at high speed, and that any defect requiring attention may also be located with greater facility in the slow speed engine.

Lubrication.

When a suitable engine has been purchased and installed, it is not sufficient to supply it with steam, but all moving parts must be sufficiently lubricated. Oiling devices of the best quality should be used and a good quality of oil is absolutely essential. It is much to be regretted that many owners do not recognize this fact, and are only too often readily convicted by the specious arguments of the salesman and a slightly lower price, to change the brand of oil.

Do not infer from this that the highest priced oil is always the best oil, neither will one brand of oil produce equally good results in all engines. By no means. When an oil has been giving satisfactory results (and this is particularly true in regard to the cylinder oils) it is dangerous to change without good reason for doing so. An oil man will often offer a trial gallon or two for test. This quantity is not sufficient for the purpose. He may propose to send a barrel of oil, promising to take back what is left and make no charge for the amount consumed it if does not prove satisfactory. He will perhaps couple with this offer his guarantee that no damage to the cylinder will result. However, I have as yet never been able to obtain the signature of the oil dealer to a legal agreement which would compel him to repair any damages traceable to the use of his oil.

The Indicator.

I need not call the attention of the engineers to the necessity of carefully watching every visible wearing part of the engine, and correcting any maladjustment the moment that it is observed; but I do wish to remind you that however well the engine seems to be working we cannot be positive of the results without a free use of the indicator. This most valuable instrument is comparatively simple in its application, and giving as it does, a correct means of determining the power output, besides a graphical representation of the action and setting of the valves, enables us to readily detect and correct many errors, which would otherwise escape our notice. If you do not own an indicator, secure a loan of one, and you will find it an invaluable aid to economical operation.

(To be continued.)

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Winnipeg, Man.— The Ryan Boiler Works, of Duluth, manufacturers of upright stationary boilers, are making arrangements to establish a factory in Winnipeg.

—⚙—

Mr. E. S. Jenison, formerly with the Henion & Hubbell Co., of Chicago, Ill., has been appointed manager of the pump department of the Canadian Fairbanks-Morse Co., Limited, who are now the exclusive sales agents in Canada for the Triplex and Power Pumps, as well as the other lines manufactured by the Goulds Mfg. Co., of Seneca Falls, N.Y.

—⚙—

Port Arthur, Ont. — Alex Ferguson, of Halifax, N.S., recently announced his intention of considering the location of a foundry for the making and repairing of boilers. Mr. Ferguson is well known in the East, having there conducted one of the oldest establishments of this kind.

THE POWER HOUSE

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USE THE NOON HOUR WISELY.

IN the summer months, it is perhaps but natural that the operative engineer should prefer joining his mates at baseball or other healthful outdoor amusement, to applying himself to more studious pursuits; but in the fall and winter, the noon hour affords a splendid opportunity for self-improvement, which should not be neglected. In the evenings, domestic and other interests may prevent many from devoting to study as much time as they could wish; but except when minor repairs and adjustments in the plant require attention, every engineer should be able to devote at least 30 minutes each noon hour to the study and discussion of the various problems which crop up from time to time in the course of his work.

In plants where several engineers are employed, small mutual self-improvement societies might be formed. These would help to develop and maintain a keener desire for knowledge, and would be of inestimable advantage both to the individuals and to their employers. In a smaller plant, of course, this would not be possible; but even there, the engineer, if he be at all anxious to advance in his profession, can usefully employ his noon hour in solving some of the problems propounded in his technical paper or in planning how best to meet a given emergency should it arise in his own plant.

The C.A.S.E. is doing good work in keeping its members supplied with a series of questions and problems relating to the profession, and these make an excellent subject for noon-hour study. If the reader will make a practice of solving even only one problem per day, he will find that the satisfaction derived from so doing amply repays the effort put forth. Every man should honestly enquire of himself how much better qualified he is for a more responsible position than he was a year ago; and then determine, if the answer is unsatisfactory, to improve matters this winter by a course of study suited to his requirements and capabilities. Application and perseverance will of course be needed; but if these are forthcoming the result will be most gratifying.

READ THE ADVERTISEMENTS!

NO engineer, whether he belong to the consulting, contracting or operating branch of the profession, can be said to have read any given issue of his trade or technical paper unless he has gone thoroughly through the advertising pages in addition to the editorial matter. Yet some readers merely give a cursory glance, or none at all, over the advertisements; careless of the valuable information they are thereby missing. To stigmatize such a mental attitude as foolish is to state the case mildly. It is comparable to that of a man who would refuse a free course of instruction in some special branch of his profession, even if it could be arranged so as not to interfere with his ordinary business and pleasures. Such a man is never in touch with the latest developments in equipment and supplies; for it is safe saying that if he will not take the trouble to read the advertising pages of a paper he certainly will not wade through complete catalogues however few or many he may receive.

On the other hand a reader who familiarizes himself with the advertisements finds them not the least interesting feature of the paper. He becomes thoroughly acquainted with the leading lines on the market and is quick to notice changes of copy. Readers are of course indebted to the advertisers for the fact that they are able to obtain their paper for so small an annual subscription, so that really they are under more or less of a moral obligation to study the "ads." May we commend to readers of The Power House the practice of a keener interest in and familiarity with this particular channel of progress and achievement.

GAS AND OIL ENGINES.

THIS number of "The Power House" contains a large proportion of editorial matter relative to Gas and Oil Engines, Gas Producers, etc., and readers of our journal are invited to peruse the information and data given in a careful and studious manner. Believing as we do that considerable development is likely to be noted in the near future through the mediums of gas and oil for power purposes, it seems advisable that engineers in every department of this important feature of present day civilization and, therefore, necessity, should endeavor to familiarize themselves with the progress being made, the difficulties being overcome, and yet to be mastered, and the possible revolutionizing of the well-established generation equipment, in the midst of which all of us, without exception, have, to a lesser or greater extent, lived, moved and had our being.

No better means of securing reliable, up-to-date records of what is being accomplished in these new departments, is to be had than through the editorial and advertising pages of a reputable technical journal, and the aim of our management is to make The Power House second to none in this respect.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

PREVENTION OF ELECTRICAL ACCIDENTS.

By H. M. Gassman.

IT is hardly possible to limit accidents entirely, but they may be greatly reduced by a careful study of the conditions. It is well to know "how to act" after an accident has happened, but is is a greater thing to prevent its happening. It is only natural to ask, "Why should we be interested in preventing accidents?" Briefly, the answers are:—First, every employer realises sooner or later that accidents represent considerable loss in money due to the liability incurred, incapacitating skilled employees and disorganizing his business. Accidents directly affect him commercially, to say nothing of the humane side. It is obvious that if an employee cooperates with him towards reducing accidents, he becomes more desirable and more highly valued. Second, from a humane point of view, an employee owes it to his fellow-employees and the public, as well as to himself and those dependent, to prevent accidental death and physical and mental suffering.

Lack of An Electrical Sense.

To the person of average intelligence, electricity is a rather mysterious thing, and there is a general feeling that everything electrical is dangerous. On the other hand, electrical accidents are often the result of disregarding natural laws applying to electricity, and a failure to appreciate the risk involved. It is a well-known fact that when the origin of a fire cannot be positively ascertained, it is attributed to the electrical wiring, where such is present. Nevertheless, the fact remains that electrical work must be considered as hazardous. It is, therefore, especially important to safeguard everyone concerned against injury. This may be in the mine, overhead, on the highway, in the mill, at the factory or the shop, in the power house, or the home. The importance of this can only be fully appreciated when we recall how little is generally known regarding electricity, that a voltage as low as 50 may prove fatal, and that moving machinery is essential to generate and usually to transform electrical energy. We can see dangerous moving machinery, hear the noise that indicates trouble, feel the heat from hot bodies before we come in contact with them, but we lack an electrical sense to detect the presence of electricity by our physical organism. Within the last decade, more or less systematic work has been done in the way of minimising accidents along industrial lines, and some legislation has been enacted in this direction.

Contributories to Electrical Accidents.

The general conditions giving rise to electrical accidents are the same as for all other industrial accidents. Among these might be mentioned the following:—Inevitable; lack of skill; carelessness; ignorance; absentmindedness; lack of guards; insufficient illumination; overwork; intoxicants; disregard of rules; lack of inspection; confusion of orders; misunderstanding; clothing; lack of supervision and management; absence of signals; lack of visual danger signs; lack of preparation before starting machinery; cleanliness, orderliness.

Inevitable.—This covers accidents that could not be prevented and for which no one in particular can be held responsible. In general, such accidents never happen twice in the same way, and there is usually a combination of circumstances leading up to the accident which could not possibly have been foreseen. Statistics from Germany show that this class covers 42 per cent. of the accidents, the remaining 58 per cent. being due to negligence of employee or employer.

Lack of Skill.—The same report from Germany shows that 20 per cent. of the industrial accidents which occur are due to lack of skill. It is therefore important that no man be put on a job unless he has had sufficient drilling or experience to make him skilled at the work. This is particularly applicable in electrical work, where men have to be drilled and trained in any particular branch of electrical work on account of the lack of suitable skilled labor.

Carelessness.—It is a well-known fact that familiarity breeds carelessness or over-confidence. This is a case of "knowing" and not "acting" accordingly. When carelessness becomes habitual, the employee should be transferred to work where there is less or no risk.

Lack of Guards.—Fully eight per cent. of German industrial accidents are due to the absence of guards. The guard may have been provided originally but not replaced by the employee when once removed. Such guards should be used to protect one from coming in contact with moving machinery, getting in the path of moving machinery, and falling into openings such as in the floors of buildings, or from walk-ways, platforms, and stairs.

Insufficient Illumination.—It is estimated that 25 per cent. of industrial accidents are due to insufficient illumination. This is particularly true where workmen pass from daylight to places lighted artificially. The artificial light may be sufficient for those accustomed to it, but the eye does not respond immediately to the change in light when passing from a very bright illumination to a place lighted at low intensity. It is therefore important that lamps be placed along walk-ways and thoroughfares rather than distributed uniformly over the whole floor.

Overwork.—Fatigue leads to carelessness, and long hours without rest are responsible for many accidents. The physical is so closely related to the mental that fatigue of one affects the other.

Disregard of Rules.—This closely borders on carelessness, but differs from it by being a wilful violation of rules, and covers such things as deeds of daring or boasting, unnecessary exposure to danger, of taking short cuts for completing a job, instead of doing it the safest way or trespassing in forbidden dangerous locations. Rules should not be made unless they will be enforced. They should be put up in such shape and so distributed that there can be no excuse for the employee not being familiar with them.

Lack of Inspection.—Machinery and apparatus deteriorates and gets out of adjustment naturally, and many accidents can be prevented by a rigid methodical and regular inspection sufficiently frequent to suit the conditions and the apparatus. Whenever unsafe con-

ditions or defects in the machinery or apparatus are discovered, the apparatus should not be continued in service, without orders from a superior, until repairs or adjustments can be made.

Rules Applicable to Electrical Workers.

The following are a few important rules applying to electrical workers; which rules, if observed, will reduce very much the risk of handling circuits of dangerous voltage, or of operating electrical machinery of any kind in any place.

No inspection, repairs, or changes of cables, wire, or apparatus should be conducted by anyone except those authorised.

No temporary work should be permitted unless it is good and safe enough mechanically and electrically to be permanent.

Only skilled and experienced workmen should be employed on hazardous jobs, and such work must be performed under the direction of a competent man at all times.

When instructions are not complete or not thoroughly understood, consult your superior and follow his directions.

Do not handle circuits promiscuously and do not get the idea that you are expert at it. Over-confidence breeds carelessness and accidents are the result. Competent men are cautious, only unskilled and inexperienced men take chances.

Avoid working on live circuits except where absolutely necessary, then take all necessary precaution to insulate yourself thoroughly from the ground and the neighboring wires of opposite polarity, using such means as are provided or as are proper for the risk involved.

Before mounting, examine carefully all poles. brackets, cross arms, etc., to see that they are safe. Do not work on defective poles unless they are properly guyed.

Inspect carefully all guy wires, anchorages, poles, towers, and brackets before putting up wire and straining.

Inspect all apparatus and tools used; if same are found defective discard them or have them repaired.

When handling wires of low voltage, such as for telephones and for signals, use the same precautions as in handling other wires with which they may become crossed. It is not safe to depend upon the insulation on the electric wires to protect you against shock. Insulation deteriorates with age, and especially when exposed to weather or the action of water in mines.

When working on live circuits use one hand at a time and keep the other behind the back. Shocks from hand to hand are the most dangerous.

Insulation on tools and rubber gloves are good things if they are ample for the voltage to be handled, but they are apt to prove a delusion, as they cannot be depended upon being in good condition and satisfactory for the purpose.

Linemen must always use safety belts when working overhead.

Avoid working on circuits running overhead or on lightning arresters while there is any sign of lightning.

Never depend entirely upon tracing out circuits; rather test them out with lamp, magneto, voltmeter, or other means.

When working on a dead circuit that might be made alive, treat it as alive.

Where circuits are controlled only from the power house, written instructions should be given to the man in charge of the power to open and close such switches as control the circuits on which work is to be done. The operator must place a tag on the switch, calling attention to danger of closing same before the work is finished. Before this switch is closed, see that everything is in the clear and everybody has been notified to keep away from the circuit.

It is the safest plan to short-circuit the circuit that has been made dead before working on it.

Switches and wires of high voltage should be placed out of ordinary reach. Where this cannot be done they must be properly guarded to prevent persons coming in contact with them.

Apparatus carrying over 250 volts must have its frame or case thoroughly grounded.

All wires must be supported securely on suitable insulators, and insulated platforms should be installed around apparatus of high voltage that is apt to be touched by the operator or other employees.

Lamps on circuits of 220 volts and higher should not be trimmed without using a suitable insulating platform to stand on.

When working on wires underground, special precautions must be taken on account of the dampness and the fact that grounded circuits are used in such places. The foregoing is part of the presidential address delivered before the Association of Electrical Engineers, Birmingham, Ala.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

FUEL ECONOMY.

WE have heard much of late about smoke abatement and the means for its prevention. Various remedies—some simple, some expensive—are suggested, but perhaps the simplest and certainly the least expensive is to educate the stoker in the elementary chemistry of the combustion of the fuel which he handles. Of course, we are aware that the majority of electric supply stations are now fitted with mechanical stokers; but we venture to think that even in the days preceding the general adoption of the automatic stoker, the men employed in feeding the boilers of electric supply works were not a high-grade of their class, and electric supply stations consequently were not infrequently "black smoke" offenders. It was, and is, the stoker in the factory who requires educating in the most economical method of boiler-firing, while at the same time avoiding the emission of anything more than a momentary puff of black smoke from the chimney stack.

By the way, why in trade catalogues is it the usual practice for manufacturers proudly to picture their factory chimneys belching forth smoke in a way that would surely cost them $25.00 and costs were it actually to happen?

To return, however, to our subject, the London Coal Smoke abatement Society and the L.C.C., having at heart the abatement of the smoke nuisance in the metropolis, a few years back commissioned Mr. Wm. H. Booth, who is a well known authority on the subject, to deliver special lectures to stokers, these lectures being given at the Borough Road Polytechnic, S.E. These lectures have been reprinted and issued in pamphlet form under the title of "Fuel Economy," and may be obtained from Messrs. S. Rentell and Co., Limited, 36 Maiden Lane, Strand, W.C., at the price of 25 cents net. The pamphlet is plentifully illustrated with diagrams, and there are few steam users who would not find it worth while to purchase it, being replete with information of everyday value.

It is just as well not to despise the outsider; he often has the best view.

REFRIGERATION DEPARTMENT

EFFECT OF VARYING SUCTION PRESSURES.

By. R. H. Karl.

AN ammonia compressor takes in ammonia gas at low pressure and low temperature. The size and speed of the compressor, or, strictly speaking, its piston displacement, is the measure of its capacity for refrigeration. If we speak of an ice machine of so many tons of refrigeration, it relates to the piston displacement per minute of the compressor. The term, "tons of refrigeration," is a misleading expression; it is too broad, admitting of different interpretations and leaving room for misunderstandings. To say, that a machine has a capacity of a certain number of tons, means that a certain quantity of ammonia gas will extract an equal amount of heat units from the brine tank to what would be necessary to melt so many tons of ice at 32 degs. F. into water at 32 degs. F.; or in other words, the latent heat of fusion is taken as a basis of refrigeration. This would be justifiable if equal results were obtained under different conditions, but this is not the case, for under certain conditions, a 50-ton machine may do only 30 tons of refrigeration, while under more favorable conditions it may do 70 tons.

Refrigeration Production Pressures.

With an ice machine the question is: Under what pressures is refrigeration to be produced? If a compressor discharges a certain number of cubic feet of ammonia gas with the least expenditure of work, that is all the machine can do; its capacity depends on the pressure of the gas entering the compressor, and the pressure against which the gas must be discharged. A pound of ammonia can either absorb or give off a certain amount of heat by changing its aggregate state, i.e., change from a liquid to a gas or from a gas to a liquid; and since a cubic foot of ammonia gas increases in weight when its pressure increases, it is evident that more refrigeration can be performed if the incoming gas is under high pressure, and, since the amount of work which must be expended depends on the pressure against which the gas is discharged, the lower this pressure, the less the work required. In other words, the nearer the two pressures can be kept together in operation, the greater the economy and capacity. Both pressures are governed by condition; the temperature of the refrigerator and the pipe surface in one case, and pipe surface, temperature and quantity of cooling water, in the other case. These conditions govern capacity and economy, and should find proper consideration when the plant is installed. This is seldom the case, for sometimes for the sake of a few dollars' worth of pipe surface the entire plant is crippled, while, on the other hand, the compressor is bought entirely too large or too small for the work it has to perform, and money is thrown away in that direction.

Suction Pressure, Capacity, Economy.

Let us see how the suction pressure of an ammonia compression machine that is, the pressure of the gas as it passes from the cooling coils to the compressor cylinder, exerts such a marked influence upon the capacity and also upon the economy of the refrigerating machine. We will first consider the formula for capacity, which is:

$$F=0.00505\ N.\ M.\ [r1-(tc-ta)];$$

in which

F=Ice melting capacity;
N=Number of strokes per minute;
M=Weight of ammonia;
r1=Latent heat just before evaporation;
tc=Temperature in condenser;
ta=Temperature in freezing coils;
0.00505 is a constant.

Since the number of strokes remains constant, it is evident that the capacity depends upon the weight of ammonia, latent heat of evaporation, temperature in the condensor and the low temperature in the freezing coils.

Referring to a table of properties of ammonia, it is seen that as the suction pressure is increased, the corresponding latent heat becomes less and the corresponding temperature rises; consequently the latent heat, temperature in condenser and freezing coils change but little with different suction pressures, and the capacity is practically proportional to the weight of ammonia circulated. Take, for instance, a suction pressure of 18.45 pounds absolute. The weight of a cubic foot of gas at that pressure is 0.0690 of a pound, while at a pressure of 38.55 pounds absolute, a cubic foot weighs 0.1384 of a pound, or twice as much; and as the same volume of ammonia gas passes through the compressor in a given time, no matter what the pressure is, the weight of ammonia circulated is proportional to the weight of the vapor per cubic foot. With the greater suction pressure, the machine will circulate double the amount of ammonia that it will with the lower pressure, and the capacity at the higher suction pressure will be nearly double that at the lower pressure.

It requires more power, in total, to operate the compressor at a higher suction pressure, but the increase in power is not proportional to the increase in capacity, because the power consumed per ton decreases as the suction pressure is raised. The power required is proportional to the heat delivered to the condenser, minus the heat taken from the cold body. The capacity is proportional to the heat taken from the cold body, therefore the ratio

$$\frac{\text{Horsepower}}{\text{Ice-melting capacity}}$$

is proportional to the

$$\frac{\text{Heat delivered to the condenser—heat taken from body cooled}}{\text{Heat taken from body cooled}}$$

The only effect on the heat delivered to the condensers when raising the suction pressure is to lower the temperature at the end of compression. The only effect on the heat taken from the body cooled is to decrease the latent heat of the liquid just before vaporization, and to increase the temperature in the freezing coils; but as the temperature in the freezing coils increases faster than the latent heat decreases, the net effect of raising the suction pressure is to increase the heat taken from the cold body. Since the heat delivered to the condenser is decreased and the heat taken from the body is increased, the fraction

$$\frac{\text{Heat delivered to the condenser—heat taken from body cooled}}{\text{Heat taken from body cooled}}$$

and the ratio

$$\frac{\text{Horsepower}}{\text{Ice-melting capacity}}$$

is decreased by raising the suction pressure, from which we perceive the important fact that increasing the suction

pressure increases both the capacity and economy of the machine.

Practical Example.

A few examples will perhaps serve to make things a little clearer. We will take a certain size compressor, for instance, a so-called 50-ton machine, to illustrate how widely refrigeration varies under different conditions. For the sake of simplicity, let it be a saturated gas compressor working without superheating. A 12-inch diameter by 24-inch stroke double-acting unit, operating at 70 revolutions per minute, is rated as 50 tons.

Case I.—If this compressor works with a suction pressure of 10.31 pounds against a condenser pressure of 200 pounds (gauge pressure), each cubic foot of ammonia vapor at 10.31 pounds pressure weighs 0.0921 pound, and each stroke of the piston displaces, nominally, 1.57 cubic feet of gas, weighing at that pressure 0.1445 pound. The example therefore reads like this: $F = 0.00505 \times 70 \times 2 \times 0.1445 \times [560.39 - (100 - 8)] \times 0.80 = 37.02$ tons. The horsepower would be about 76.2, so this machine would fall short about 13 tons from its rated capacity.

Case II.—When the same compressor is operated with a suction pressure of 27.28 and a condenser pressure of 170 pounds, the weight of ammonia discharged per stroke is 0.2366 pounds. Thus, at the same speed, this compressor will have a capacity of $F=0.00505 \times 70 \times 2 \times 0.2366 \times [546.88 - (91 - 14)] \times 0.80=62.88$ tons. The horsepower will be about 83.2. This example shows the foolishness of buying a machine of "50 tons capacity" without knowing under what conditions it will have to work for this compressor—

Case III.—It will only develop its rated capacity with a suction pressure of 18.68 pounds and a condensor pressure of 180 pounds at the same speed and efficiency, and the example will read like this: $F = 0.00505 \times 70 \times 2 \times 0.1903 [553.04 - (94 - 4)] \times .80=49.81$ tons. The horsepower will be about 80.4.

Case IV.—The same compressor may, however, produce a great deal more. In cooling work in a brewery with a suction pressure of 44.72 pounds and a condenser pressure of 180.43 pounds, the weight of ammonia discharged per stroke is 0.3295, and then the output is increased to $F=0.00505 \times 70 \times 2 \times 0.3295 \times [531.96 - (94 - 30)] \times 0.80=88.15$ tons. The horse-power required will be about 91.2.

Varying Effects Apparent.

From the above examples, it is seen that the effects of increasing the suction pressure with the same machine, same speed, etc., can be considerable. Comparing Case III. where the compressor is working at its rated capacity of 50 tons of refrigreation with about 1.6 horsepower per ton, with Case I, where the same machine with the same speed, etc., works at a lower suction pressure and 2 horsepower per ton, it is seen that the capacity under Case I is reduced 25.6 per cent., while the horsepower per ton is increased 27.5 per cent.

Comparing Case III with Case II it is seen that by increasing the suction pressure from 18.68 pounds to 27.28 pounds, the capacity of the compressor at the same speed, etc.; is increased in Case II. to 62.88 tons, which means 13 tons increase, or 26.2 per cent., while the horsepower per ton has decreased from 1.61 to 1.32, or about 18 per cent. less power per ton.

Comparing Case II. with Case I., we find that raising the suction pressure from 10.31 pounds to 27.28 pounds resulted in increasing the capacity of the compressor 70 per cent., and the total power 9 per cent. only; accordingly, the extra 25.8 tons refrigeration are obtained at an expenditure of only 83.2—76.2 =7 horsepower.

The volumetric efficiency assumed here is 80 per cent. This agrees with results obtained in practical tests; in some cases it is more and in some cases less, depending upon how well the machine is designed or operated, and upon the skill of the operator in keeping the machine in first-class condition. The principal and unavoidable losses are self-reduction of the liquid and suction depression; the other losses, such as superheating, leaking of piston and valves and excessive clearance, can be reduced to a minimum. In the above examples, 20 per cent. also has been added to the theoretical horsepower to make up for losses in friction, etc.

Operating Hints.

Operate your machine with as high a suction pressure and as low a head pressure as possible while maintaining the required temperatures. Use the indicator, learn to analyze the cards, and you will be surprised at the defects they disclose. The compression curve of an indicator card from an ammonia compressor should be compared with the adiabatic and isothermal curves. It tells of the work performed by the machine, shows excessive clearance and re-expansion losses, also leaky or defective valves and piston. Calculations can be made to show the extent of these losses. All of these items are very important if the machine is to be operated at its full efficiency, and the indicator should be used frequently on an ice machine, as it tells immediately if there is anything wrong with the compressor or with the system in general. It is not necessary to make exhaustive and expensive tests, for the simple indicator card tells the story in full.

The foregoing is a synopsis of a paper read at the second annual meeting of operating engineers in New York.

BOILER FEED AND CONDENSER WATERS.

MR. E. E. BASCH finds that, although boiler feed-water is softened, it cannot be said to be purified by treatment with "permutite," or artificial zeolites, since the salts which cause incrustation are merely replaced by soluble ones, such as sodium carbonate and sulphate. On evaporation, the water becomes rich in these soluble salts, which must be removed periodically, whereby much heat is lost, and the cost of treatment with permutite is thus increased. According to Messrs. Cribb and Arnaud in 1905, water containing more than a certain proportion of alkali does not attack iron, and according to Messrs. Heyn and Bauer in 1908, the presence of a considerable quantity of sodium carbonate in water retards the rusting of iron.

The conditions that obtain in boilers, however, are much more complex than those under which the experiments of these workers were made. According to recent experiments, sodium chloride prevents the protective influence of sodium carbonate on iron. Practical experience has shown that water which has been treated with permutite is liable to froth in the boiler, owing to the presence of alkali, besides causing corrosion.

The most satisfactory boiler feed-water is, of course, condensed steam, if oil can be kept from it. It is of importance to note that W. Heym has devised an electrolytic separation of oil from condenser waters. He states in Elektrochemie Zeitschrift for 1912 that the oil which separates in the condenser water from steam engines is apparently present in a condition similar to that of a negative colloid. It is suggested that it should be removed by electrolysis of the condenser water, to which sodium carbonate, or other salt, has been added, between iron electrodes.

Siemens Company of Canada, Ltd.—A company has recently been incorporated, to be known as the Siemens Company, of Canada, Ltd., which will act as sole representatives of the "Associated Siemens Companies" in Canada. The head office of the new company will be situated in the Transportation Building, Montreal, and the existing offices in Toronto and Winnipeg will be taken over in due course as branch offices. Mr. Arthur S. Herbert, present Canadian manager, has been appointed general manager, Mr. J. W. Brooks manager of the Toronto office, and Mr. C. W. Stokes will continue, as hitherto, manager in Winnipeg.

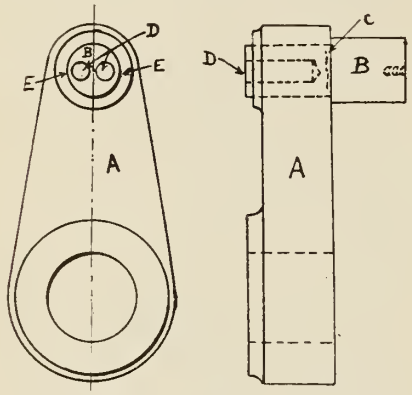
THE READERS' POINT OF VIEW

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

EXTRACTING FRACTURED CRANK PINS.

By Alfred V. Begbie.

IN the drawing, A represents the crank arm and B the crank fractured at C. To remove the pin, two holes (D) are drilled with the aid of a ratchet or some easier method. These holes should be of such size as to remove as much metal



EXTRACTING FRACTURED CRANK PINS.

across the diameter of the pin as possible, without endangering the hole in the crank arm, and of depth to come short of the fracture. The web between the two holes is next cut through with a chisel, and if necessary to still further weaken the pin, a round nose chisel may be used to thin down the walls between the holes D and the hole in the crank arm at EE. By placing a steel bar in one of the holes D and with a good husky man at the end of a sledge handle and a suitable block on the face of the crank, the offending pin is usually easy to drive out.

CLAY SUBSTITUTE FOR RE-BABBITTING.

By E. N. J.

AS a clay substitute to use in re-babbitting bearing boxes, here is an original wrinkle. It sticks like, billy eh! will not blow out or soften with hot metal contact, and can be used many times over by the addition of a very small quantity of oil when softening it again. It is better than clay or putty when either are used alone.

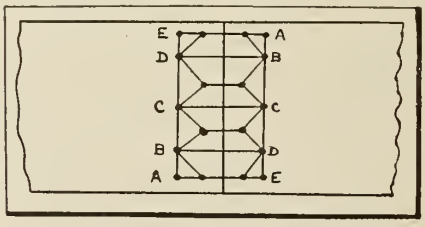
Reduce putty with cylinder oil until it is almost as thin as the oil itself; next take some powdered asbestos — bits of old asbestos pipe covering ground up will do; add the latter to the putty mixture until you get a stiff compound as dense as the putty was in its first state. Use it any old way and it will give entire satisfaction.

BELT LACING.

By Chief Engineer.

THE recent discussion on styles of belt lacing reminds me of the unusual one here illustrated. Although a rather fancy affair, it is very serviceable. This lacing should only be used on belts over 8 inches width, as it is too elaborate for small belts. However, after lacing a few joints, it will be found possible to make this joint about as rapidly as the ordinary types. The unique feature of this lacing lies in its being the same on both sides of the belt. Since it contains angles and triangles many will claim that it is no good, and that all lacing should be straight on the pulley side. The designer himself made the foregoing remark to me; further stating that he had been lacing belts off and on for over twenty years and had never used a style giving better satisfaction than this one.

There are five holes at the back and only four at the front edge, which is di-



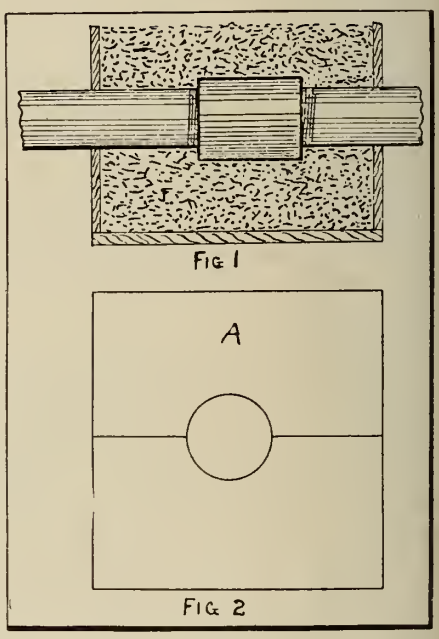
UNUSUAL STYLE BELT LACING.

rectly opposite to the usual practice. The lacing is started at the center and finished at E on each side. Holes A, B, C, D, E, are laced once more, then if all the other holes are double laced the holes mentioned are laced three ply. It is said that when well hammered with a wooden mallet, the joint will run smoothly and outwear many straight-laced styles.

LEAKY PIPE COUPLING.

By John Thorn.

A FOUR-INCH suction pipe on a steam pump started to leak, due to corrosion, around the treads at the ends of a coupling. The engineer had no tools to work pipe of this size and as it would require time to get men and material from the city, some miles away, while in the meantime water was re-



LEAKY PIPE COUPLING.

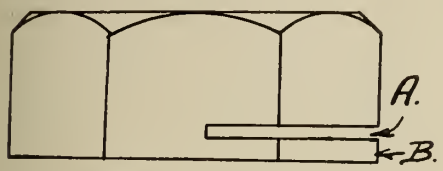
quired almost continually, he made a box 18 inches square and open on top. The ends were in two pieces with a 4½ inch hole cut inthe centre. The box was placed around the coupling and the top halves of ends (A), being loose, were put in place and nailed firmly; some dry cotton wick was rolled and tied around the coupling where the leaks showed and the box filled to the top with a mixture of plaster of Paris, sand and Portland cement. This was given a couple of hours to set before starting the

pump. Needless to say, the outcome of the scheme was a success, and as several months have now elapsed, there is no expectation of further trouble. Of course, this kink would be of no use on a pipe carrying pressure.

SIMPLE SAFE LOCK NUT.

By Union Man.

TO make a nut that will never get loose by vibration, cut a slot in it with a hacksaw as at A, before threading. With a cold chisel as a wedge,



SIMPLE, SAFE LOCK NUT.

force the piece B down a little Now thread the nut, apply and tighten up in place, and no lock nut will be necessary.

WRITING TO TECHNICAL PAPERS.

By Operator.

I WOULD like to refer to your recent editorials asking engineers to write you some pointers. I was an engineer for many years before I attempted to do so, always believing it to be a lot harder than it really is. I now collect most of my church money from the technical press. I give them any wrinkle I come across and they give me their coin when the wrinkle is worth it.

A paragraph I once read about this subject is as follows: Before one can run he must learn to crawl and then to walk. The best way then for the new writer tackling his first story is to tell it in the same way he would relate it to one of his mates, and if he has a message, the editor will come back at him to get all the points he has omitted. This, of course, takes time but editors of the technical press find it worth while.

C.A.S.E. EDUCATIONAL WORK.

By A. Kastella, Executive Secretary.

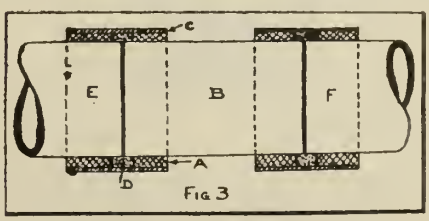
In your issue of September last, you prophesied the probable results of the C.A.S.E. Educational Committee work. I am under the impression that you may have misunderstood the intention of the aforesaid committee, as you can only see a probable disappointment for the promoters.

You state that education must be imparted; to this we take no objection as this is part of our programme. With regard to the "Questions and Answers" contained in books being a help to men or otherwise, it is really immaterial to the committee, as they intend to give to its members what is considered best for our special purpose. The committee are prepared to offer all that is desirable from an engineer's point of view. Where questions are asked and answers are given, it is for the set purpose of furthering the ambitions of the individual member. Our work is not intended to be a catechism, but that which will advance any one along certain lines of instruction to attain the most desired results. The education of our members cannot be run on straight-laced methods of procedure; rather have we to adopt ourselves to a practice whereby our members can be attracted and held, while our scheme is imparted to them. When we can show to them that our interest is theirs also, we shall have no trouble in arousing in all members of the C.A.S.E. an enthusiasm which will be hard to lose. The committee intend to have the work to fit in with the beginner, so that when progress is made, something of a higher order will be from time to time instituted. It is not the intention of the committee to stand pat on one form of instruction paper. We know that there are in our lodges, members who act as instructors, taking the work of their local lodge in hand, thereby imparting valuable education to their fellows. Some of our lodges have evenings set apart for this purpose, which shows a willingness to achieve greater results. Thanking you for your sympathy in our efforts which we hope will be for the benefit of the engineers, and not a hopeless disappointment.

BURST WROUGHT IRON PIPE

By Steamfitter.

LAST winter an engineer struck a snag. A wrought iron pipe 3 inches diameter froze up and burst. It was a cold water pipe in more ways than



BURST W.I. PIPE REPAIR.

one before it was fixed, being in a place very difficult to reach. As it meant breaking a couple of walls to withdraw the lenghth, he used a hack saw and cut out the piece shown at B. He next cut another piece of good pipe, of equal length, and being impossible to thread the ends E and F, the problem of how to make connection confronted him. Engineers as a rule are hard men to stick. He secured two 5-inch couplings, placed them over the ends E and F, and ran them back far enough to get the new piece of threadless pipe B inserted. The couplings were then placed in the positions shown. Oakum was packed into the centres as shown at D and lead run into the ends as shown at A. After caulking up the latter firmly the water pressure (80 lbs. to the square inch), was turned on, and no trouble has been experienced since.

WATER-SOFTENING BY THE AID OF ALUMINIUM.

THE water-softening process of Herr Brandes, a Hanover chemist, has been tested in the Vienna experimental station for steam and heat technics by the Vienna Association for the Examination and Insurance of Boilers on behalf of the Austrian Patent Office. In this process the feed water is passed over a corrugated aluminium plate while exposed to the action of light. The experiments which are published in the Zeitschrift der Dampfkesseluntersuchungs and Versicherungs-Gesellschaft of July and August, were made with a Meunier boiler of 2,440 sq. ft. heating surface and 10 atmospheres pressure. Three experimental runs, each lasting 200 hours, were conducted. In the first experiment, the water was pased through an aluminium trough while being illuminated; in the second series the trough was kept covered while the feed water passed through it; in the third series the feed water was not treated in any way. The amount of scale deposited per kilogramme of feed-water was 0.011 gramme in the first case, 0.025 gramme in the second, and 0.051 gramme in the third case. The ratio of these figures is 1:2.5:5, so that it would appear that the simple influence of light is about as important as that of the aluminium. The lengths of time required for removing all the boiler scale, after the three tests, were in about the same proportion—namely, 40, 108, and 186 hours.

Mr. William Kennedy, Jr., Montreal, will in all probability be retained by the fire, water and light committee of Winnipeg as consulting hydraulic engineer in connection with the Point du Bois power plant.

PROGRESS IN NEW EQUIPMENT

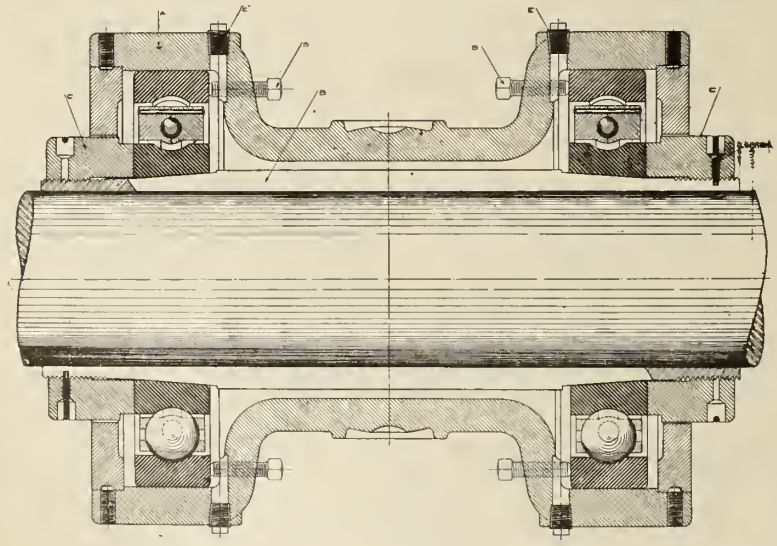
There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

EXTRA HEAVY DUTY BALL BEARING.

THE Chapman Double Ball Bearing Company of Canada, Ltd., Sorauren Avenue, Toronto, have just added to their regular line a new type of ball bearing specially suited for heavy duty transmission work. These bearings are regularly made in all sizes from 1 7-16 inches to 6 inches diameter inclusive, the one herewith illustrated being of the latter size. This is probably the largest standard bearing regularly manufactured by any company for transmission purposes.

As may be seen from the illustration, the bearing is of the double annular type, the large balls being 1⅞ inches diameter, and the smaller intermediate balls 11-16 inch diameter. The ball races are of best chrome vanadium steel, the cages being phosphor bronze. The sleeve (B) is made from a steel casting split partly through into six segments to allow of its being securely clamped upon the shaft by the heavy cast-iron nuts or collars (C). These collars are threaded with an Acme thread and securely locked by means of C-springs. Sufficient adjustment is provided to allow the bearing to be properly fitted to shafts varying from .005-inch oversize to .005-inch undersize. The housing is made specially heavy to give the races ample support and prevent their deformation under load. The lubricant (vaseline) is retained by the end caps seen in the cut. These bearings are designed to fit any standard type of hanger. The 6-inch bearing here shown weighs approximately 650 pounds.

In manufacturing work of this class it will of course be understood that a very high degree of accuracy is absolutely necessary. The ball races are hardened and afterwards ground on special machines which ensure absolute uniformity. In making the cages, special jigs and fixtures are used to ensure correct relationship between the large and the small balls. The balls themselves are imported from Europe under a guarantee that each one is accurate to .0001 inch; but even with this guarantee, every ball, no matter what its size, is micrometered and tested on receipt.



EXTRA HEAVY DUTY BALL BEARING

When installing these bearings they are slipped on the shaft and then placed in their hangers. After the shaft is coupled up, aligned and leveled, the collars (C) are screwed up until the sleeve (B) is tight on the shaft. The set screws (S) are for the purpose of preventing the bearing, when being placed on the shaft, from sliding on the sleeve and causing the latter to collapse. When the bearing is in place, and before the sleeve is clamped to the shaft by the collars (C), the set screws are slackened back about ¼ inch clear of the ball races.

The Chapman Double Ball Bearing Co. has recently shipped to the Mississquoi Marble Co., Phillipsburg, Que., a complete transmission equipment, including six of these large bearings. Two of them are to take the pull of a 47-inch, 3-ply leather belt transmitting 360 horsepower. The main line shaft is 360 feet in length and reduces in size from 5 15-16 inches to 4 7-16 inches.

Another order now being shipped calls for 413 bearings of sizes varying from 2 5-16 inches to 4 7-16 inches, for the St. Maurice Valley Cotton Co., Three Rivers, Que. This is the third mill belonging to the same syndicate which has been so equipped, the other two being the Wabasso Cotton Co., Three Rivers, and the Shawinigan Falls Knitting Co., Shawinigan Falls.

LUNKENHEIMER "PUDDLED" SEMI-STEEL VALVES.

THE increasing use of high pressures and superheated steam has created a demand for something better than the ordinary cast iron, brass mounted valves. To meet this demand, the Lunkenheimer Co. are putting a line of "Puddled" semi-steel valves on the market.

"Puddled" semi-steel is high grade iron and steel alloy, of very close grain and great strength, and should not be confounded with the mixtures made in cupolas, generally. The Lunkenheimer method is to melt the iron and steel together in a specially modified "Puddling" furnace, thoroughly mixing them during the process, and by pouring off at the proper time and temperature, securing an invariably uniform alloy. The best grade of Lake Superior Iron is used exclusively, and the percentage of deleterious chemical elements is kept very low, a result hardly realizable in a cupola.

High Pressure.

By the above process, the tensile strength is ordinarily maintained at 35,000 pounds, which is over 100 per cent. stronger than the cast iron used in the majority of valves, and about 50 per cent. stronger than that used in Lunkenheimer Valves. These "Puddled" semi-steel valves are being extensively used in plants carrying high pressure superheated steam, and in other places where the physical demands on a valve are great, and in every case, we understand, they are giving complete satisfaction.

They are made in two combinations as regards the material used for the trimmings, and are designated as combinations (C) and (D); the object being to suit various conditions of superheat and to meet the specifications of engineers who differ as to the metal that should be used in the trimmings. Combination (C) is guaranteed for 600 degrees Fahrenheit temperature and combination (D) for 550 degrees. Both combinations are suitable for 250 pounds pressure per square inch. The line includes Globe, Angle, Cross, Check, Gate, Non-return Safety Boiler Stop Valves, etc., and for extreme conditions of pressure, superheat and strain, is made of cast steel, the tensile strength of which is about 80,000 pounds per square inch. For lower pressures and temperatures, high grade cast iron is used.

OIL ENGINES FOR LAND AND MARINE PURPOSES.

DURING the month of September of this year an oil industries exhibition was held in London, England, the purpose of which was to show the progress and development being made and accomplished in the field of power generation through the medium of oil, variously adapted and applied. The paper read by Mr. C. Lakin-Smith on the subject of "Oil Engines for Land and Marine Purposes," deals in an interesting and highly instructive manner with leading phases of the constructional, operating and competitive features of prominent types of such prime movers, and will, therefore, tend to familiarize the reader with what has already been accomplished, the difficulties to be overcome, and the prospects ahead for a widespread adoption in the power plant field.

Restrospective, Present and Future.

If we look back over a period of 25 years, we find that the oil engine was then used in quite small sizes mostly for domestic purposes, and its best friends did not consider it a serious competitor with gas or steam. During the last few years, however, wonderful and rapid changes have taken place which have resulted in the universal adoption of the oil engine for automobiles, aeroplanes, etc., and in its being a keen competitor with gas and steam for all purposes except for the largest horse powers. Engines of the Diesel type are now being built up to 7,200 h.p. in six cylinders of 1,200 h.p. each, and the Diesel Engine Co. state that they are prepared to accept orders for 9,000 h.p. engines in six cylinders of 1,500 h.p. each. Other firms again, are experimenting with even higher powers up to 2,000 h.p. per cylinder. The somewhat popular idea, therefore, that the oil engine can only compete for the small work is erroneous. There is no class of work to-day where the oil engine is not represented, and I cannot even exclude railway work, as an experimental Diesel locomotive of 1,000 h.p., and also a rail motor of 200 h.p. are already accomplished facts.

For canals, the oil engine is destined to play a most important part. On the Grand Canal Company's system in Ireland there are now 48 barges fitted with Bolinder crude oil engines, while there are a large number in use in this country. The usual horse power employed for a barge 70 ft. by 7 ft. is 15 h.p., which enables two other barges to be towed, and, taking into consideration the additional cargo capacity available of 5 to 7 tons, it can safely be said that the oil engine can be used at one-third the cost of a steam engine, and a further point in its favor is that neither constant nor skilled attention is necessary.

Engine Types for General Purposes.

The almost sudden popularity of the oil engine for all purposes, apart from the question of the larger powers now available, is due—(1) to the demand for lower fuel costs; (2) to the demand for a saving in weight and space; (3) to the demand for a fuel that can be more easily handled and stored, and the great improvement recently made in oil engine manufacture.

The different types of oil engines, as applied to general purposes, will now be considered, their particular applications to marine work being dealt with later on. I would mention, here, that my remarks refer to the single-acting engines only, as I believe this type of engine has come to stay, for the range of sizes now made, although for still larger sizes, above, say 2,000 h.p. per cylinder, the double-acting engine will probably have to be adopted in spite of its obvious complications. In comparing steam and oil engines it must always be borne in mind that in the one case the working fluid is entirely manufactured outside the cylinder, whereas in the other case its manufacture is completed inside the cylinder. The classification of the various types can be done in many ways, with numerous subdivisions, but they must at any rate be classified as 2-cycle and 4-cycle engines, the Diesel and the hot bulb type, some of which use the heavier and some the lighter oils. I would point out, that, the Diesel engine being in a distinct class of its own and dealt with separately later on, many remarks, speaking generally of the oil engine, do not necessarily apply to it.

The 4-Cycle Engine.

The operation of the 4-cycle engine, better known perhaps as the Otto cycle, which gives a working stroke every two revolutions, is too well known to need a full description, and it will suffice to say that after the working stroke, the next three strokes are occupied with the ejection of the exhaust gases, drawing in a fresh charge, and then compressing it. The weaker points in this type of engine are due to its having only one working stroke for every two revolutions, its larger size, and its less regular turning movement, which necessitates the use of heavy flywheels when a regular turning movement is essential.

The 2-Cycle Engine.

In the 2-cycle engine, at the end of the working stroke, the exhaust and inlet valves or ports are opened almost simultaneously, and compressed air rushing into the cylinder is used first as a scavenging charge expelling the exhaust gases and is afterwards compressed on the upstroke of the piston, after both valves or ports are closed. The objection to this type lies in the fact that some means of air compressing has to be adopted which naturally reduces the mechanical efficiency, and thereby increases the fuel consumption from, say, 5 to 8 per cent., and also the fact that increased attention must be given to the dissipation of heat from the cylinder walls owing to there being an explosion at each revolution. If it were not for this loss in mechanical efficiency, the 2-cycle engine would be the more economical, as in the case of the 4-cycle engine, the gas has more time to become decomposed and to be deposited on the cylinder walls. All 2-cycle engines, however, have a great advantage in addition to the question of size and regular turning movement in being able to be made valveless, which is important both as regards reliability and the cost of attendance and repairs. The saving in running costs under these last two heads, certainly counterbalances and often more than counterbalances the loss in mechanical efficiency.

Fuel Supply.

In the cylinder of an oil engine the time available for combustion is very small, and consequently it is essential that the gas be such, or fed in such a way, as to ensure almost instantaneous

combustion. If the oil is insufficient in quantity the combustion is very slow and there is then a chance of pre-ignition, caused through a lingering flame still burning when the end of the working stroke is reached. If, on the other hand, the mixture is too highly charged with oil vapour, and insufficient oxygen is present, the combustion is probably incomplete and a deposit is left in the cylinder and other passages.

Ignition.

Beau-de Rochas, the inventor of the Otto cycle, intended that compression should continue to the point of spontaneous combustion, so as to avoid the complications of ignition devices, but on this point he was wrong, as the temperature of the charge drawn in on the suction stroke would vary to some extent with the temperature of the cylinder walls, depending upon the load the engine was doing, and thus making pre-ignition always likely. Where this form of ignition by spontaneous combustion is used, the fuel must not enter the cylinder until the time for firing the charge has arrived, and for other forms of ignition the electric spark, hot bulb or tube are usually adopted.

Carburation.

The ordinary method of carburation of the lighter oils, such as petrol, consists in drawing the air required for combustion at considerable speed through a passage contracted at a point and surrounding a nozzle at which the spirit stands at constant level. In all of the many types of carburetters, this is the usual principle adopted, but for the heavy oils external heat is required, and for this purpose the exhaust gases are often used and the apparatus is usually called a vaporizer. In the hot bulb type of engine, however, the matter is more simple, the oil being pumped direct into the ball, which is kept hot by the working of the engine and there vaporized.

Governing.

The governing of an oil engine is a point of particular importance and is often put forward as an objection to their adoption by steam engine makers. There are two principal methods, the one known as the "hit and miss," whereby a working stroke of the engine is entirely cut out, and the other by means of which the supply of fuel is regulated to suit the load and no working strokes are missed. Other methods consist in prematurely opening the exhaust valve or keeping it closed, but these are hardly in general use. On light loads, the "hit and miss" principle has the advantage in fuel consumption, the mixture being kept constant at all loads, whereas with the graduated charge, the mixture may vary and also the amount of compression. Water injection is now generally used and is found not only to increase the efficiency of the engine, but to allow the compression to be carried to a higher point without increasing the risk of pre-ignition.

Comparative Costs of Steam, Gas and Oil Engines.

As far as comparative figures are concerned for fuel costs and efficiencies for steam, gas and oil engines, the only means of obtaining accurate and average figures is to use those published in the returns of electricity supply undertakings. Mr. Charles Day, in a paper recently read at Portsmouth, gave the following figures of fuel costs, having worked out the average figure from all central stations up to 1,000 H.P.:—

	Cents	Load factor
Steam	.9	14.7
Gas	.86	15.3
Oil	.46	14.3

The figure given here for oil is remarkable by comparison, and emphasizes the large saving to be effected in standby losses on a low road factor; the standby losses very probably amounting to 20 or 25 per cent. The figures he quotes for repairs are also very favorable to oil engines, but as probably the various oil plants were fairly new and the rest of the plants fairly old, I have omitted the figures.

Mr. Peiffer, in his paper of May 31st, 1909, gives the following comparative figures for the thermal efficiency at a 52 per cent. load factor, which again shows the superiority of the oil engine:

Steam ..... 8.7 per cent.
Gas .....14.5 per cent.
Oil .....27.8 per cent.

All these figures, however, naturally favor the oil engine on account of the standby losses alone, but I think the following figures will to-day give a fair comparison for the thermal and mechanical efficiencies, and are such as we may expect to meet in daily practice, not being makers' figures or the results of special tests:—

	Efficiency Thermal	Mechanical Efficiency	
Steam	10.12%	92%	(forced lubrication)
Gas	18.20%	80%	(forced lubrication)
Oil	28.30%	74%	(4-cycle Diesel).

The Diesel Engine.

The leading features of this engine are: (1) Carrying the compression until an ignition temperature has been reached, thus avoiding all ignition devices; (2) injecting the fuel after the compression is completed, thus avoiding all possibility of pre-ignition; (3) the fuel is injected gradually for 1-10 stroke, and no explosion takes place; (4) governing is carried out by altering the period of injection as well as the quantity of fuel. The advance in efficiency made by this engine can be attributed to its high compression up to about 500 lbs., and the method adopted of spraying in the oil with a further injection of air at about 800 lbs. In the 4-cycle land engine the fuel valve is usually placed in the centre of the cylinder cover, with the inlet and exhaust valves on either side of the ordinary mushroom type, but with removable seats, and in addition a starting valve. In the 2-cycle engine, the exhaust valve is dispensed with, though the scavenge air valve is an addition, the other valves being arranged on the cover as on the 4-cycle engine. A separate fuel pump for each cylinder is generally supplied, which has the advantage of making each cylinder independent of the others, and the right supply of oil more certain.

The compressed air for starting is obtained either from a separately driven compressor or (1) by driving the compressor from the crosshead or (2) by connecting it to the end of the crank shaft, and the scavenge air pump is driven generally by one of the two latter methods. All these details of general arrangement vary with the different makes, each maker striking out a line of his own. The engines for the largest powers are built with as many as eight cylinders, which is probably the greatest number practicable, and if in this direction the limit has been reached, and also in the sizes of the cylinders, due to the very high pressures and temperatures, we must then fall back on the double-acting engine for the still larger sizes.

Diesel Engine Fuel Consumption.

The fuel consumption of these engines is not only remarkable for its lowness, but for comparatively small difference between the various sizes. The following are the present guaranteed figures of the Diesel Engine Company for their 4-cycle engine, to which 3 to 4 per cent. must be added for the 2-cycle engines to balance the loss in mechanical efficiency:

25	H.P. ...	.49 lb.	per	horsepower.
33	" ...	.48 lb.	"	"
40	" ...	.46 lb.	"	"
50	" ...	.44 lb.	"	"
80	" ...	.42 lb.	"	"
135	" ...	.42 lb.	"	"
156	" ...	.41 lb.	"	"

From 150 H.P. upwards, as far as present sizes go, the figure of .41 appears to remain constant, and thus there is only a difference of .08 from the smallest to the largest.

Power Economy

That's what every Power Plant Engineer strives to attain. How can you do it if your pump valves are being cut out with foreign matter in your water? How can you make any kind of a showing if your Condenser Tubes are clogged up with refuse, leaves, etc.? Is your time valuable? Can your plant show up well if it is continually being shut down for repairs?

Some shut-downs are unavoidable, but anything wrong in your water supply line can be remedied by installing a **Twin Strainer.**

What! You say you want **evidence** of what the **Twin Strainer** will do? Look at the above cut. It is not an exaggeration, but is a reproduced photograph showing a six-hour catch of fish, muskrats, leaves, etc., made by a Twin Strainer. If you want to know more about the Twin write for our Strainer Catalogue.

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A Statement of Facts and Figures

1-16 in. of scale means 8 to 10% waste of fuel.
1-8 in. of scale means 15 to 20% waste of fuel.
1-4 in. of scale means 25 to 30% waste of fuel.
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How long will it take to save the price of a LIBERTY CLEANER? You say you have no scale in YOUR Boilers. Do you know this for a FACT, or are you GUESSING?

When your boilers are clean, you not only save the cost of the fuel, but the extra labor in handling it. We have known plants, where, after getting rid of the scale, were able to reduce the number of firemen.

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POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

Goose Bay, Anyox.—The Copper Creek Mining Co. has let a contract to the Armstrong Machine Co., Spokane, Wash., for installation of a 3-ton refrigerating plant in the mine hotel.

Victoria.—The B. C. Market Co. have let contract for installation in the market at Fort and Cook streets, of a 4-ton "Alaskan" refrigerating plant, to the Modern Refrigerating Co., Vancouver, B.C.

Vancouver.—The Merchants Ice & Cold Storage Co., it is stated, will begin construction of its proposed cold storage plant, on Richards and Pacific avenues, to cost about $65,000, early in October.

Vancouver.—There was recently completed for the Hotel Vancouver's new power house, at the rear of the present hotel building, a smoke stack which stands 225 feet above the ground and extends to a depth of about thirty feet under the surface. It is of reinforced concrete, lined with firebrick to a height of ninety feet. Reinforced concrete only is used above that point. In constructing it, 150 ⅝-inch steel reinforcing rods were used. Each of these rods is about thirty feet in length. Twenty-four 1-inch rods were also used in the reinforcing of the stack together with large quantity of ½ inch hooping. Some idea of the size of the stack will be gained from the following figures: Thickness through base, which is octagonal in shape, 13 feet; inside measurement of stack from top to bottom, 7 feet; height above sidewalk 225 feet; total height 255 feet from base to top. Messrs. Skene & Christie were the contractors.

Vancouver.—To build a dam for the proposed reservoir on Seymour Creek will cost $632,000, says a report submitted to the water committee recently from Consulting Engineer Burwell. This figure includes in addition to the actual dam itself, items for land clearing, installation of a new main up some four miles from the existing intake, debenture loss, contingencies, etc. The various items noted in the figures from the engineer were:—Construction of concrete dam and intake $150,000; clearing 400 acres to be flooded by reservoir, $120,000; 48-inch steel main to dam from present intake, 18,600 feet, $186,000; construction of four miles of pipe line roadway, $20,000; tunnelling, 700 feet, $10,000; cribbing, 600 feet, $3,000; engineering expenses $27,000; debenture loss and contingencies $116,000; total $632,000. The committee appointed Ald. Williamson, Enright, Hepburn and Trimble to look into the project, together with City Engineer Fellowes.

ALBERTA.

Medicine Hat.—Sir Max Aitken is applying to Medicine Hat for a 20-year street railway franchise.

Edmonton.—The superintendent of Edmonton municipal street railway recommends that 35 new cars be ordered for early delivery to supplement the 45 now in use. In August the system carried 6,803,005 passengers, as compared with 3,768,004 in the same month in 1911.

SASKATCHEWAN.

Moose Jaw.—The management of the Moose Jaw Electric Street Railway Co. will increase the size of their car-barns at a cost of $30,000. They will also install a new generator of 500 k.w. capacity.

Moose Jaw.—The city is still using the old septic tanks for the sewage from the city, as the report from Mr. Carter of the Canadian Rand Co., has not yet been received. The new sewage disposal plant was used for about a week, but as the ejectors and automatic switchboard did not work altogether to the satisfaction of the City Engineer he asked that Mr. Carter investigate and report on the matter. This was done, and in the meantime the city was compelled to revert back to the old mode of treating the sewage, instead of the new and up-to-date plant which has recently been completed. The City Engineer stated that he intended to have everything to his satisfaction before he would take the plant over from the contractors. In this connection, he said, he found that the contractors were anxious to have everything working properly as the system in use here is the only one of its kind in the West, and it will be used as an advertisement in securing other contracts.

Yorkton.—Sealed tenders addressed to T. F. Acheson, Secretary-treasurer, and marked "Tenders for Electrical Plant," will be received until 12 o'clock noon, October 31st, 1912, for the following:—One 500 B.H. Diesel Engine direct conpled to alternator and exciter; One switchboard with auxiliary panel and series tungsten lighting apparatus; Specifications can be obtained on application to the office of the Town Electrical Engineer.

Moose Jaw.—The Moose Jaw Cold Storage Co. are having their new warehouse equipped with a 30-ton "York" refrigerating plant, by the Kent Co., Montreal, Que.

MANITOBA.

Winnipeg.—The municipal fire, water and light committee considered the matter of enlarging the Point du Bois power plant. According to Power Manager Glassco, this must be done previous to next fall, and he estimates the cost of two additional power units at $250,000.00.

Winnipeg.—The Manitoba Cold Storage Co., Ltd., S. H. Maccoll, manager, who are building new cold stores, are erecting a 3-storey and basement structure, with foundation capable of carrying eight storeys. The building will be 111x150 feet, or provide about 1,200,000 cubic feet of cold storage space. A 250-ton refrigerating plant is to be installed.

Winnipeg.—The Consumers' Ice Co., recently organized, will build a 100-ton raw water ice making plant at Norwood, a suburb of Winnipeg, but with provision for increasing this to 300 tons, as the demand for ice may warrant. The plant is to be completed by April 1, 1913. A large number of auto-trucks for ice delivery will be purchased. The officers of the company are: W. S. Thompson, president; A. J. Andrews, vice-president; J. R. Forman, secretary-treasurer; F. E. Cryder, manager. Contract for machinery has been let to the Creamery Package Mfg. Co., DeKalb, Ill.

ONTARIO.

Stamford Township. — Negotiations have been entered into between the officials of this municipality and the management of the Canadian Niagara Power Company regarding the installation of a waterworks system in the township.

Ottawa.—The municipal board of control will recommend that 16 new arc lights and 28 tungsten standards be installed at once.

Welland.—The municipal council have closed a contract with the Hydro-Electric Commission for a supply of power for this town.

Ayr.—The ratepayers of this municipality voted in favor of purchasing the electric light plant.

Toronto.—S. King, Esq., has had his apartment house equipped with a 2-ton "York" refrigerating plant; installation by the Kent Co., Montreal.

Oshawa.—The ratepayers voted for the electric light by-law. The proposal was to merge the existing electric light and gas lighting contracts into one, and give the town practically double the lighting, and in more modern fashion, for practically the same outlay in money. The by-law received a substantial majority.

Niagara Falls.—Announcement has been made that the Niagara, Lockport and Ontario Power Co., American distributing agent of the Ontario Power Co., had obtained control of the Salmon River Power Co. The latter company's generating plant will be used to obviate the necessity of constructing a second transmission line from Niagara Falls, N.Y., to Rochester and Syracuse.

Sarnia.—The plans for the new quarter-million-dollar waterworks for supplying pure water from Lake Huron to the citizens of Sarnia and Point Edward, have been accepted by the Provisional Board of Health as satisfactory. The by-law will now be prepared, and a vote taken by the people. Opinion on the waterworks question is divided, although the majority favor the new plant.

Berlin.—P. W. Sotham, of Toronto, until recently the chief engineer of the Hydro-Electric Commission, is competing with the Light Commission in an effort to land the big power contract for the Canadian Consolidated Rubber Company's new tire factory. The company made a request for 13,000 horse-power, and as yet the Hydro-Electric Commission has not submitted the charge for that amount. The company now informs the Light Commission that Mr. Sotham has offered to supply power at 25 per cent. less than the Hydro-Electric.

Windsor.—The Edison Electric Company, of Detroit, has commenced work on a large lighting plant on the river front in Sandwich, which when completed, it is expected will supply current for both heating and lighting to the towns of Essex, Leamington and Amherstburg. These towns are at present supplied by small local plants at a cost considerably higher than will be charged by a single central system. It was originally planned to bring the current across the river from Detroit by cables, but this idea was abandoned in favor of an individual plant. It is not improbable that when the new company gets its machinery in running order that an attempt will be made to compete with Windsor, Sandwich and Amherstburg Street Railway, which concern has for years enjoyed a monopoly of the lighting business in Windsor.

Toronto.—The 220-foot smokestack is nearly completed for the C. P. R. heating plant at the foot of King street. The heating plant is in the building running from the subway at Main St. through to King St., and in which will be housed the Dominion Express Company in addition to the Alexandra hotel servants' quarters. It contains also the heating plant for the hotel and the depot. This building is being erected by John Gunn & Sons. The smokestack is being built by the Canadian Kellogg Company, of Montreal and Winnipeg, under the superintendency of H. B. Welling. The stack goes down 23 feet below grade and is built of reinforced concrete. At the base it is 17 feet in diameter and tapers to 5 feet 10 inches at the top. The wall tapers from 10½ inches at the bottom to 6 inches in thickness at the top. It is erected by means of a movable steel form especially constructed for taper work and which is moved upwards 6 feet 3 inches every day.

Stratford.—The ratepayers will vote on the street railway proposition which has been made by Sir William Mackenzie of the Canadian Northern Railway. The franchise calls for a twenty-five-year agreement.

Niagara Falls.—The municipal council have received the following tenders for the supply and installation of a new centrifugal pump:

Canada Foundry Co.	$4,370
Caledonia Iron Works	6,025
Escher-Wyss Co.	4,750
Drummond McCall Co.	6,500
Buffalo Steam Pump Co.	6,244

Goderich.—Asking for an assurance that their line would be able to get Hydro power, representatives of the Goderich, Kincardine and Southampton Electric Railway waited upon the Hydro-Electric Commission recently. The municipalities interested have, it was stated, guaranteed the bonds of the railway to a large extent, but a further sum was needed to complete the line, and they declined to back the bonds any further. Mr. Proudfoot, local member for Centre Huron, who appeared on behalf of the railway, stated that if the company was given a definite assurance of power the needed money could be raised. Hon. Mr. Beck stated that just as soon as the town of Goderich entered into a contract with the commission work would be started and the company could get all the power necessary.

The town has already carried the necessary by-law.

Kingston, Ont.—The Roberts Filter Co., Philadelphia, have made an offer to the Civic Utilities Committee to erect and equip a filtration plant to care for city's water supply, at a cost of $54,000. The proposition will be considered.

QUEBEC.

Montreal.—The Frontenac Breweries, Ltd., who are building a large brewing plant, will have same equipped with a 250-ton refrigerating machine having two 22x42 inch Corliss engines; contract for which was let to the Vilter Mfg. Co., Milwaukee, Wis.

Montreal.—The Centrefreeze Sanitary Ice Co. has been organized, to establish an ice making plant, of about 200 tons daily capacity.

Montreal.—The Societe Francaise Specialite Allmentaires is having installed, by the Kent Co., an 8-ton belt-driven "York" refrigerating plant.

Montreal.—The N. K. Fairbank Co., Ltd., are installing a 42-ton refrigerating machine, with 16x36 inch Corliss engine, in addition to their present plant; machinery furnished by the Vilter Mfg. Co., Milwaukee, Wis.

Montreal.—The Wm. Davies Co., Ltd., who recently completed an addition to their cold storage plant, are having the new rooms fitted with some 22,000 lineal feet of 2-inch direct expansion piping, furnished by the York Manufacturing Co., York, Pa., and installed by the Kent Co., Montreal.

Montreal. — Messrs. Allis-Chalmers-Bullock, Ltd., Montreal, have secured contracts for two municipal lighting and power systems at St. Jerome, P.Q., and Grand Mere, P.Q., the engineers for both being Messrs. Surveyor and Frigon, of Montreal. The hydro-electric power plant for St. Jerome will be situated on the North River, and for Grand Mere on the Shawinigan River.

NEW BRUNSWICK.

Fredericton.—The Grand Falls Company, Limited, the new company headed by Sir William Van Horne, which is to spend upwards of $8,000,000 in the development of the water-power at Grand and in the erection of pulp and paper mills, has made its first move towards commencing its undertaking. An order-in-council has been passed empowering Hon. J. K. Flemming, as Surveyor-General, to convey by deed to the company the waterpower and five acres of land along the banks of the river upon payment of $60,000. Below the falls only one-half of the river can be conveyed to the company, the other half being held by the Crown for ordnance purposes.

Sussex.—Town have placed order with general contractors, E. Leonard & Sons, for a brick set 80 h.p. boiler, also a National feed water heater 50 h.p. to operate spare steam pump. Engineer, C. D. Mills.

CATALOGUES.

Schuchardt & Schutte have sent us their catalogue of tacographs and tachometers, showing the various types of apparatus which they sell. The catalogue is illustrated with the best cuts obtainable. It has a section on general remarks followed by one on mechanical details. There are also dimension sketches of the various instruments and illustrations of all types, both portable and stationary. A complete list of pocket tachometers is also shown. A copy of this catalogue will be sent free on request to the Montreal Office, Coristine Building.

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SALESMEN WANTED

LAKE ERIE BOILER COMPOUND CO. REquire a few first-class representatives to sell their well-known compound. Liberal commission paid to live men, and exclusive territory. Write at once, giving references, 11 Colborne St., Toronto. (tf)

WANTED

MOST FAVORABLE TERMS WILL BE given to any firm wishful to take up sole agency for our Patent Flexible Metallic Face Steam Packings. S. Redfern & Co., Swan Lane, Manchester, England. (11)

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For city and town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc. One-half the cost of Iron Pipe—and better.

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2 Tandem Compound Wheelock Engines, cylinders 21 in. and 38 in. x 46 in. stroke.
2 Fly-wheels, 18 feet diameter, 46 in. face.
2 Double leather belts each 112 ft. long, 42 in. wide.
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All the above water and steam connections in very good order.

Price $3000

The above plant will be sold at this extraordinary price, one-seventh of its cost, to anyone who will remove it at his own cost. Plant discarded for larger plant, is only reason for selling.

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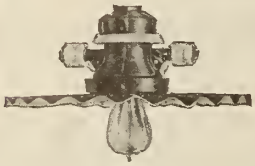

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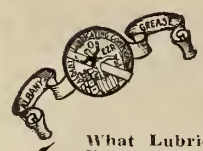

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What Lubricant will you use on your engine?
Will you buy some "just as good" lubricant, because some theory seems to prove that it ought to be a good friction reducer?
Or will you spend your money for a lubricant that you know to be good? One that has been thoroughly tried and proved?
Albany Grease is first, last and above every other lubricant on the market, of absolutely known worth.
Don't keep on using the wrong lubricant in the wrong place. Send for a free copy of our new book, "Death to Friction," and get straightened out.
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BIG

RESULTS
from small investments. This little advertisement will give you an idea of the use you can make of smal space.

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Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

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Minister of Agriculture

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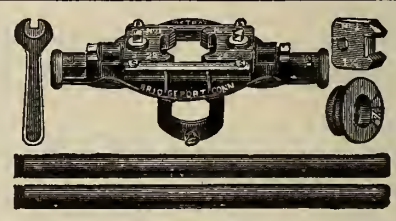

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ARMSTRONG STOCKS
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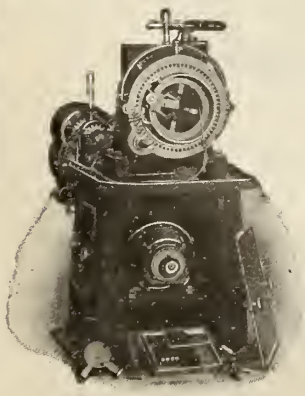

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But more quality, more operating convenience or higher efficiency isn't on the market.

That may sound a little boastful, but if you will acquaint yourself fully with the Forbes' ideal construction, and the advantages to be derived from the enclosed motor drive, the quelever control, its portability, etc., you'll agree with us.

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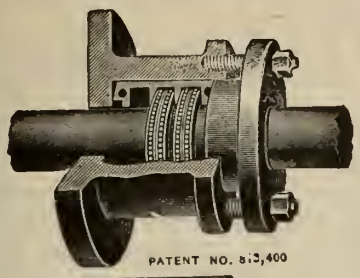

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HOLMES'

Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

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FLEXIBLE STEEL

Makes Joints Quickly.

Only a Hammer Required.

No Holes to Punch.

Forms the Strongest Part of The BELT.

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Fabers No. 368, Slide Rule, specially graduated for Electrical Computations.

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The Nokoros Patent Union

The only union made absolutely Non-Corrosive. Brass to iron in all contact points. Ball joint; Octagon ends, any wrench can be used. Adapted for heavy service. Every union air tested at factory. Send for circular B, describing the above and other fittings made by

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We are the largest firm in Canada making a specialty of the production of **Sanitary Cotton Wiping Cloths** by a new up-to-date process.

We are supplying the largest manufacturing plants, power houses and machine shops throughout the Dominion.

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We also are manufacturers and large importers of cotton and wool waste. We can quote the very best prices.

Prices and samples of both waste and wipers sent free on request.

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Mueller Pressure Reducing and Regulating Valves

Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

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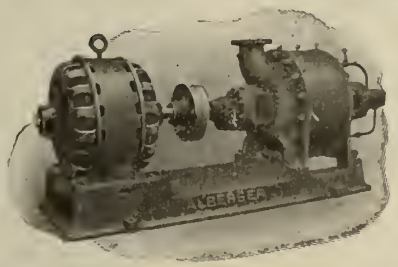
More Water



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Alberger Pump and Condenser Co.

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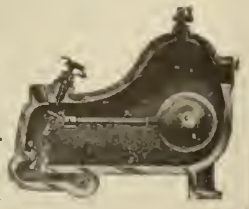
McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



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IDEAL STEAM SEPARATOR & SUPPLY CO.

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An entertaining book for those interested in mechanics and power, dealing with the scientific and mechanical inventions of Watt's life and times and his relations with other noted scientists and inventors.

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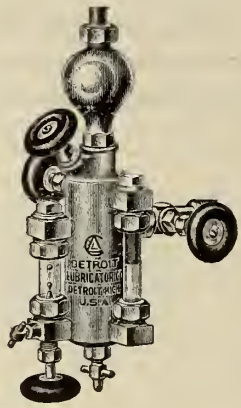
for every purpose

The Detroit line includes lubricators for service with every type of steam or gas engine, air compressor or machinery of any kind. One of these lubricators will enable you to eliminate every element of chance or uncertainty from the lubrication of your machine.



Every Detroit Lubricator is the product of scientific study of the conditions under which it operates and embodies every requisite for efficient, dependable, economical lubrication.

NEW CATALOG

The big new Detroit catalog tells about all the different kinds of Detroit Lubricators and gives valuable information on the lubrication of all kinds of machinery.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

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When All Others Fail

GERMAN VALVE CYLINDER OIL,
GERMAN ENGINE OIL,
STERLING FAST ENGINE AND DYNAMO OIL,
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will cure your troubles.

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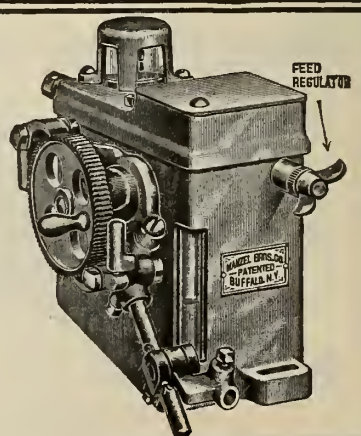
Let Us Send You a Manzel Oil Saving Oil Pump on Thirty Days' Trial

30% OIL SAVING GUARANTEED

You may be able to save as high as 60%. Many others have done so. The "Manzel" New Model Oil Saving Oil Pump is a positive lubricator. It oils the cylinders right all the time, and makes a big reduction in oil bills, besides saving labor and wear and tear on the engine.

You can try a "Manzel" Pump with the distinct understanding that it may be returned at our expense if it doesn't reduce your oil bills at least 30%.

Send for one on these conditions. Catalogue on request.



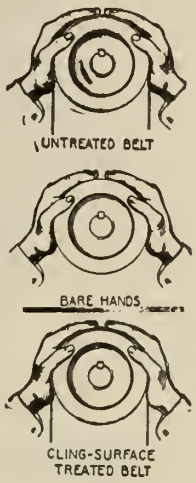
MANZEL PUMPS are carried in stock by

THE TWIN CITY OIL CO.
General Agents Ontario and Quebec
Berlin, Ontario.

BAYFIELD & ARCHIBALD
General Agents for the Northwest.
Molsons Bank Bldg., Vancouver, B.C.

Write to either of the above firms for catalog and full information. MANZEL BROTHERS CO., Buffalo, N.Y.

A simple test that demonstrates the action of Cling - Surface



Fasten any ordinary small pulley in some convenient position and with fingers as shown grip an untreated belt. Next grip the pulley with bare hands only and then try the same thing with a Cling-Surface-treated belt. You can easily feel the decided difference in resistance to slip.

It is simply a matter of cohesive contact. The untreated belt, being hard and inelastic can't be expected to conform perfectly to the pulley face, while the bare hand, being moist and soft and yielding takes equally effective hold over all area covered. Similarly a belt treated with Cling-Surface becomes pliable and moist so that it offers the same high resistance to slip, but is never sticky on the surface. Cling-Surface imparts and maintains the soft velvety cling in, but leaves no deposit on, the belt surface, hence there need be no collection of dust or forming of lumps. Further, the prevention of slip is accomplished by cohesion, not adhesion. The belt leaves the pulley without effort after contact, which is in marked contrast to the action where a sticky preparation holds pulley and belt together at the expense of power loss and injured belt surface in tearing them apart.

A belt consistently treated with Cling-Surface is alive to its duty all the time, hence can be run easy or slack thus reducing the risk of hot-boxes, increasing life of bearings, saving expense and attention for lubrication, repairs, etc. In addition to this, the belt itself is kept mellow, preserved, waterproofed and in best condition always and its steady delivery improves the service from the driven machinery.

Cling-Surface therefore is the basis for systematic and scientific belt management—not a remedy for sick belts, but a means of securing the highest ultimate economy and efficiency from all the belting.

Cling-Surface can be tried at our expense. Its real value shows up in a hurry and the far reaching results are certainly worth investigation. You will be well repaid by at least sending for literature.

Cling-Surface Co.

1057 Niagara Street Buffalo N Y

47

This brand of leather belting Costs less per day of service than any other

LEATHER BELTING

(WATERPROOF)

Get some and keep tab on it.

Sadler & Haworth

Tanners and Manufacturers

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For over 35 years the makers of the best leather belts

which does make a difference to you.

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ESTABLISHED 1879. PHONE MAIN 4881.

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ROADWAY & SIDEWALK CONSTRUCTION
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WATERWORKS SEWER AND CONDUIT CONSTRUCTION ETC

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TORONTO, April 17th. 1911.
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The Federel Engineering & Supplies Ltd.
284 Yonge Street,
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Gentlemen;-

In reply to your inquiry in refsrencs to Scandinavia Belting, we have used it for the past two years,and it has given us svery satisfection.

One drive in particuler has been running out of doors and exposed to all kinds of weether. Indoor belts are exposed to extreme heat and dust

We find that under these conditions Scandinavie Belting is working exceedingly well.

Yours very truly,

GODSON CONTRACTING COMPANY,
Per H. H. Baker C. E.

SCANDINAVIA
FEDERAL ENGINEERING & SUPPLIES LIMITED
TORONTO
BELTING

The accompanying letter explains itself and will give you some reasons why Scandinavia is a satisfactory belt.

Sole Agents for Canada:

FEDERAL ENGINEERING & SUPPLIES LIMITED

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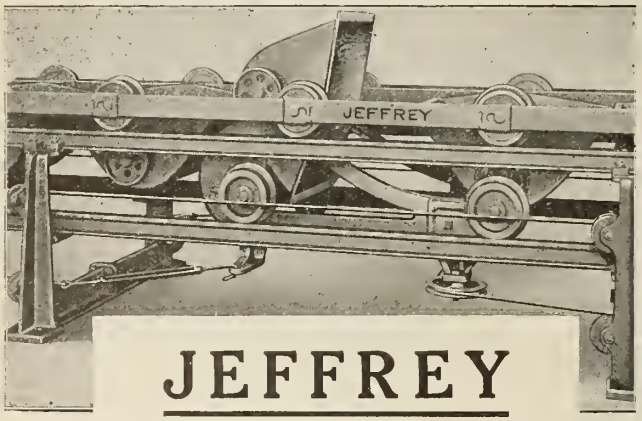

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For handling Coal and Ashes in Power Plants

Bucket Tripper is arranged to travel over the entire length of runway and may be set to dump the buckets at any point.

With this equipment Buckets can be loaded anywhere along the horizontal run without employing any special feeding device.

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Equipments for the Low Cost of Handling Materials

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Power House Coal and Ash Handling Systems

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Do not continue the old way—change your methods at once and you will be surprised with the results obtained after installing the modern way of handling materials.

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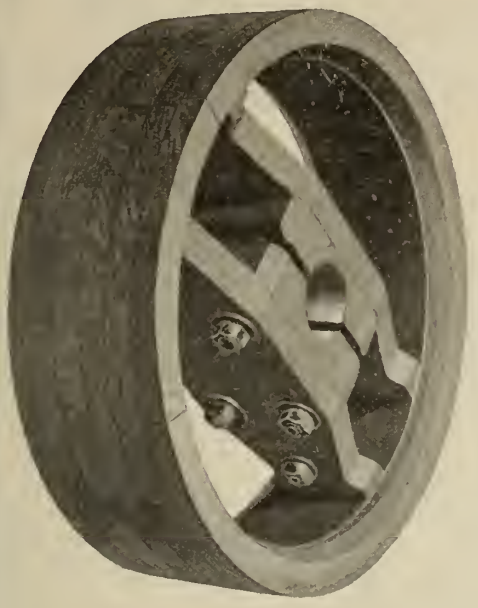
A Combination Hard to Beat



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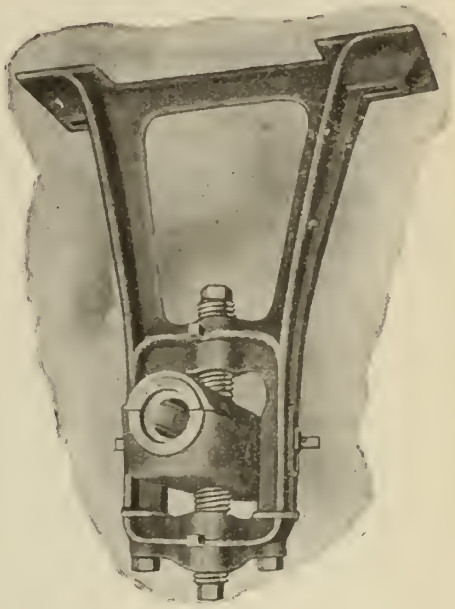
The Elmira B. & S. Hangers are designed to meet the hardest and most exacting conditions. They are of good weight, correct design, and well proportioned. A Duplex system of oiling is employed consisting of tempered steel rings and woven cotton wick.

The Elmira Pulley is built to stand the hardest service and most severe conditions. The rim is nailed throughout. The arms are tenoned into the rim and dowelled there. The pulley is guaranteed to run wherever a leather belt will give satisfaction.



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is increasingly a habit with those who buy much Belting.

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"MAPLE LEAF" BRAND Stitched Cotton Duck Belting

It is the most economical Belting because it is durable under every condition; even where other Belting will deteriorate rapidly. It is water proof.

It runs absolutely true on the Pulleys.

It is built of plies of selected duck.

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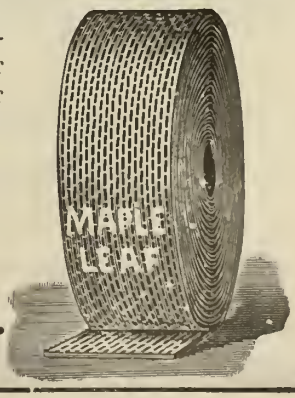

DOMINION BELTING CO., Ltd.
HAMILTON, CANADA

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EVERY month The Power House receives letters from subscribers stating that they are in the market for certain articles, but that they do not know where they can be procured.

They ask us if we can tell them from what source they can procure the wanted articles. This is a service we render cheerfully.

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We have facilities for procuring information about new appliances which have not been extensively advertised, and these facilities are at the service of our readers.

We are glad to get these requests for information and no service could be more cheerfully rendered.

CUT OUT THE COUPON BELOW, and use it when you would like us to give you information.

THE POWER HOUSE

143 University Avenue, Toronto

THE POWER HOUSE
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TORONTO

For Subscribers

INFORMATION WANTED

DATE_____ 191

PLEASE TELL ME WHERE I CAN BUY_____

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NAME_____

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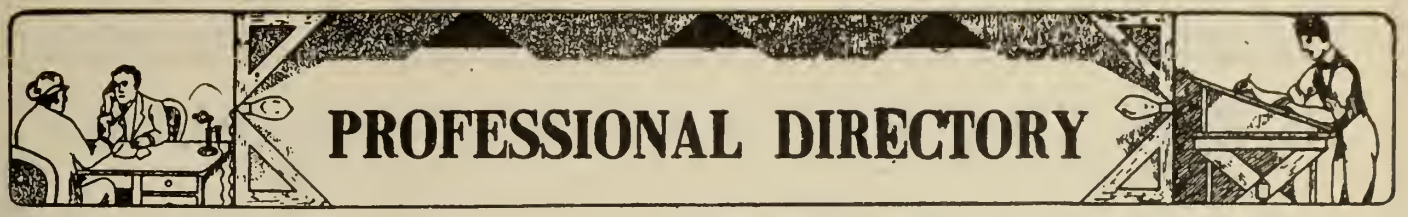

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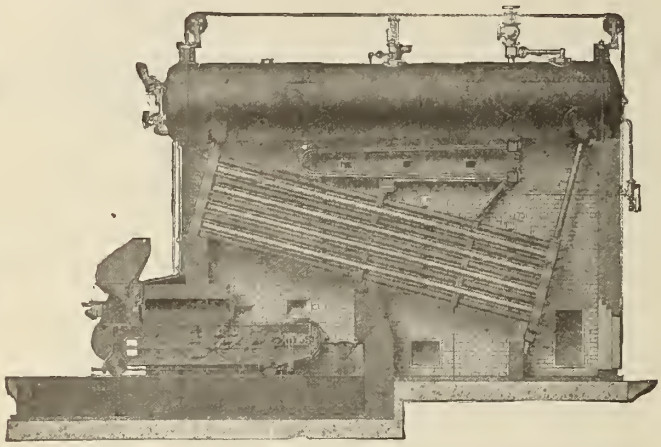

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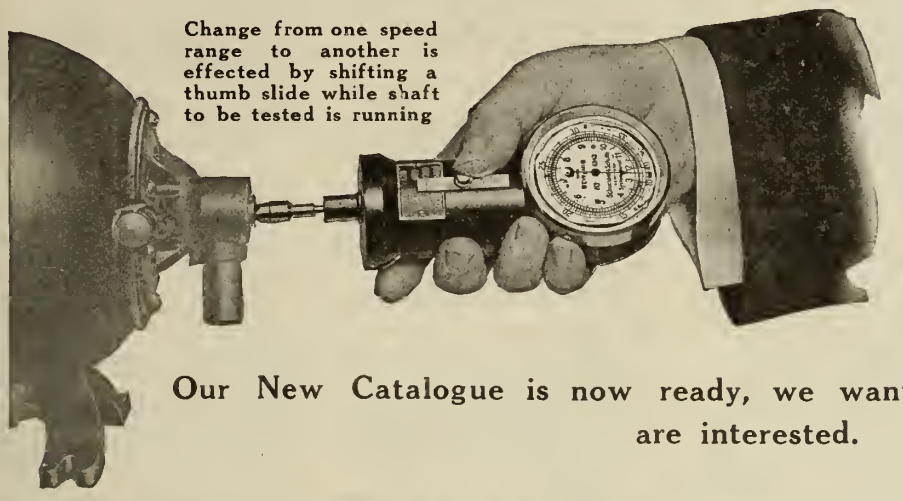

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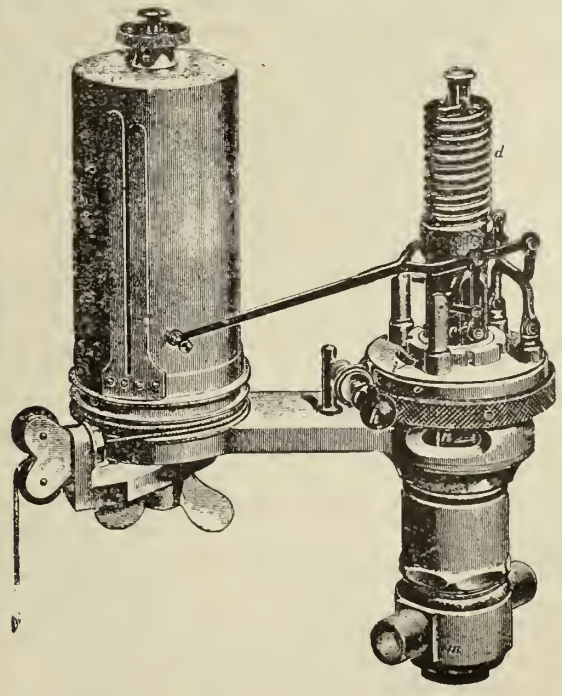

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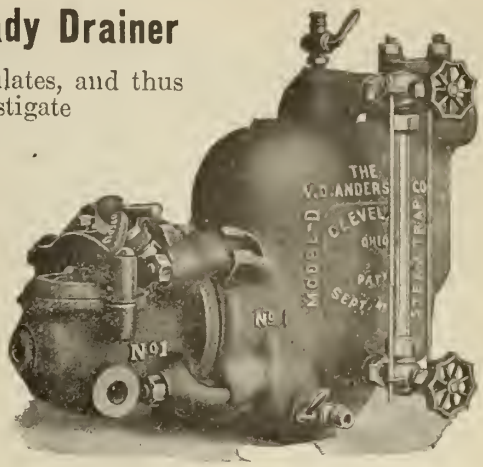

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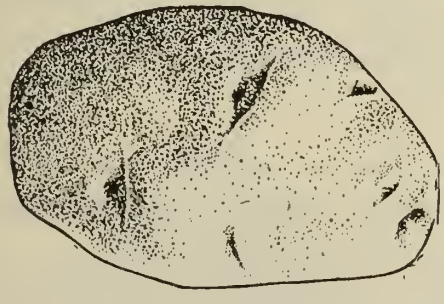

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Eugene F. Phillips Electrical Works, Ltd., Montreal.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Wire, Railway Feeder and Trolley.
Canadian General Electric Co., Ltd., Toronto.
Eugene F. Phillips Electrical Works, Ltd., Montreal.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Which Journal do you use as a Directory when in the Market for Power Plant Equipment and Supplies?

THIS directory is run every month at considerable expense for the benefit of our army of readers—your benefit.

¶ In it you will find listed practically everything used in connection with your plant, and you will find under each heading anywhere from one to a dozen names to whom you can write regarding the article wanted.

¶ Turn from this directory to our advertising pages and study carefully what our advertisers say regarding their product.

¶ You do not derive half the benefit from any one issue of "The Power House" until you have studied the advertising pages.

¶ The manufacturer who is spending his life in perfecting his product, tells you there just what he has that is going to help you get better results from your plant.

¶ And getting better results is going to increase the size of your weekly envelope.

¶ Look over this issue carefully—then look over your plant. You're sure to discover some things advertised that, if installed in your plant, would help to put you in right with the boss.

Use "THE POWER HOUSE" Directory—you will find it complete and you will help your favorite Journal.

Eugene F. Phillips Electrical Works, Limited
MONTREAL CANADA

Bare and Insulated Electric Wire
Electric Light Line Wire. Incandescent or Flexible Cords.

Railway Feeder and Trolley Wire
Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.

HALIFAX TORONTO WINNIPEG VANCOUVER

The advertiser would like to know where you saw his advertisement—tell him.

NEWTYPE BERGMANN LAMPS

(Tungsten Filament)

THE UNBREAKABLE KIND

Are now ready for delivery. We guarantee delivery to you in good condition.

EXCLUSIVE CANADIAN DISTRIBUTOR:

P. H. KLEIN, Jr., CO.

Live Agents wanted all over Canada. 329 Craig Street West MONTREAL

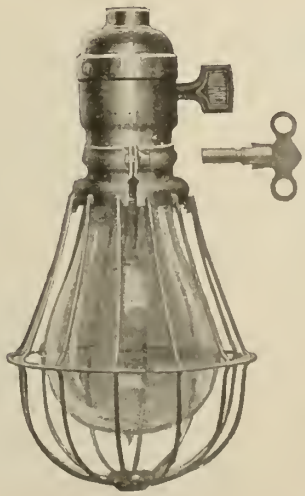
MONARCH ELECTRIC CO., Limited

ST. LAMBERT, P.Q.

District of Montreal.

WE GIVE SATISFACTION

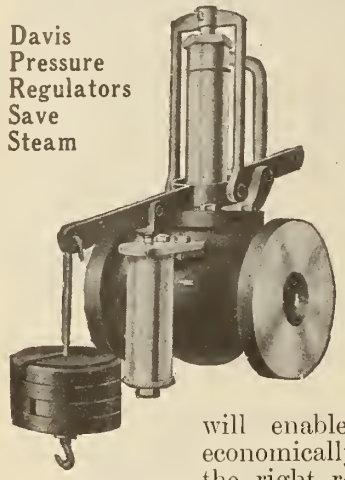
SEVERAL LINES WE MANUFACTURE AND CARRY IN STOCK



The advertiser would like to know where you saw his advertisement—tell him.

Save 50% in Your Steam Consumption

Davis Pressure Regulators Save Steam



THE chances are that you are using steam somewhere in your plant at a higher pressure than is necessary. If you are using full boiler pressure, where a much lower pressure would do the work as well, you are wasting steam every minute that your plant is running.

Suppose your boiler pressure is 100 pounds and you can use steam for some purpose at 40 pounds or less. Such a reduction would mean a saving of at least 50% in steam consumption—a saving which you can not well afford to neglect.

The Davis Pressure Regulator

will enable you to use steam economically by delivering just the right reduced pressure. No matter what the boiler pressure may be or how much it may fluctuate, this valve can be set to automatically maintain any constant service pressure. Use it wherever conditions demand a reduced pressure and you will save steam enough to pay for it in a surprisingly short time.

The Davis Pressure Regulator is a simple efficient device of unquestionable merit. It has no springs, toggles, packing, auxiliary valve or diaphragm. Its principle of operation is the balancing of pressure by direct weights, which makes it positive in its action and easy to adjust for any working condition.

We uuconditionally guarantee this valve. It is sold on approval and must fully show its merit. It is your privilege to return it if you are not entirely satisfied. Let us seud you one for inspection and test.

Jobbers and Dealers Everywhere Sell Davis Valve Specialties

G. M. DAVIS REGULATOR COMPANY Established 1875 **434 Milwaukee Avenue, Chicago**

NEW YORK	BOSTON	ST. LOUIS	PHILADELPHIA	PITTSBURGH	SAN FRANCISCO
123 Liberty St.	70 High St.	735 S. Fourth St.	2528 N. American St.	Park Building	Rialto Building

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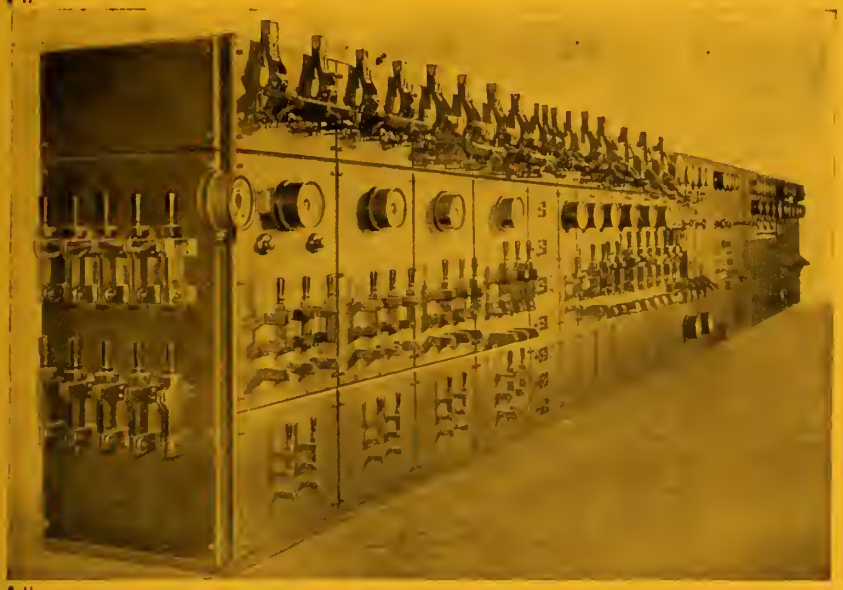
The building of heavy capacity switchboards, of the quality and character illustrated, requirers the highest engineering talent and exceptional manufacturing facilities.



Westinghouse Switchboards

are designed by the foremost engineers in the world and built complete in a factory specially equipped for the purpose. They are Westinghouse Products from start to finish.

The board illustrated controls circuits of various capacities for a large industrial plant—A. C. and D. C. circuits ranging in capacity from 230 to 2,300 volts, and from 200 to 4,500 amperes Direct Current, and 30 to 1,200 amperes alternating current.

The apparatus and circuits controlled comprise the following:
Two 750 K.w., 250 Volt Rotaries.
Two 100 Kw., 125 Volt Exciters.
Three 1,500 Kva., 2,200 Volt Turbo Generators.
Six 2,200 Volt single phase Transformers.
Eight 230 Volt D. C. Feeders.
Ten 230 to 2,200 Volt A.C. Feeders.

Canadian Westinghouse Co., Limited, Hamilton, Ontario

TORONTO Traders Bank Bldg. | MONTREAL 52 Victoria Square | OTTAWA Ahearn & Soper, Ltd. | HALIFAX Telephone Bldg. | WINNIPEG 158 Portage Ave. E. | CALGARY 311 8th Ave. West | VANCOUVER Bank of Ottawa Bldg.

ESCHER-WYSS-WATER-WHEELS TURBINES AND IMPULSE-WHEELS

HEAD OFFICE FOR CANADA:

515 Canadian Express Bldg.,

MONTREAL, Que.

AGENTS:

ONTARIO:

C. J. Printz, 127 Delaware Ave., Toronto.

MAN., SASK., ALTA.

C. L. Trimingham, 45 Canada Life Bldg., Winnipeg, Man.

BRITISH COLUMBIA:

Frank Darling & Co., Homer Street, Vancouver, B.C.

High Grade

Boiler Room Accessories

Absolutely Guaranteed

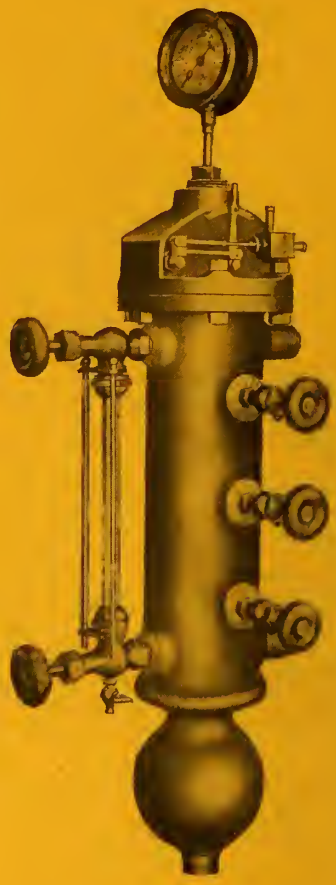
Klinger Type Water Gauge

Strong and durable. Mounted with Reflex Glass. Practically unbreakable.

The progressive power plant should not hesitate about getting in touch with us. Our steam goods are dependable at all times and will stand the most severe service. We have a line of Boiler Fittings which we offer to the trade as the most satisfactory kind procurable. Our reputation for quality and our iron-clad guarantee are your protection. You must be well satisfied before you pay a cent.

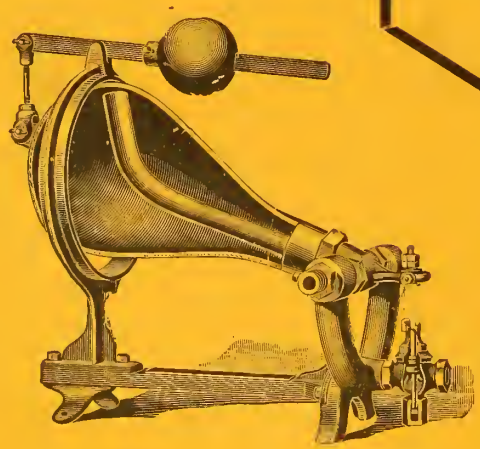
We have every requirement for your steam heating system. Now is the time to make repairs, installations or extensions. We will be pleased to quote prices on lines in which you are interested.

Illustrated Catalog the Trade.



"Reliable" Water Column Complete

With Water Gauge Mountings, Gange Cocks, and Pressure Gauge.



Bundy Return Steam Trap

At Reduced Price

This trap has a long record of good service. You cannot buy better value in return Steam Traps than this one. Absolutely guaranteed.

TRADE MARK J.M.T. REGISTERED A GUARANTEE OF QUALITY

Heintz Steam Trap

A Thermostatic Trap; operates at a variation of one degree of temperature, simplicity in construction, can be placed in any position. The ideal trap for heating coils, and machines operated by steam. They automatically relieve all condensation. Thousands in daily use.

The James Morrison Brass Mfg. Co., Limited

93-97 Adelaide Street West, TORONTO

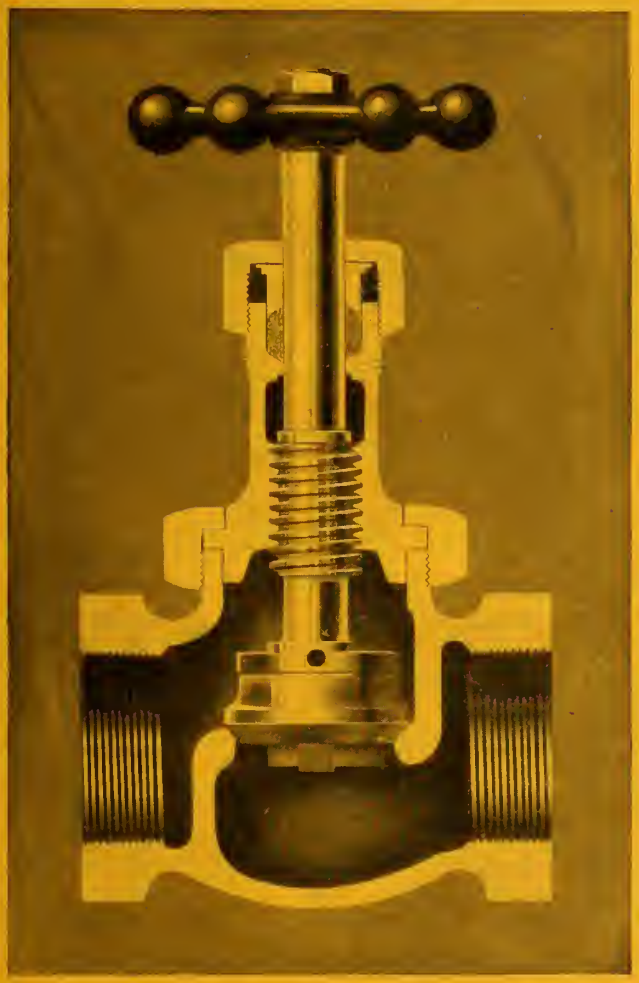
Special Feature—Articles on Feed Water

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143 149 University Ave LONDON, ENG.: 88 Fleet St. E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. V. Publication Office, Toronto—November, 1912 No. 11



"SOMETHING BETTER IN VALVES"

Guaranteed to stand a constant working pressure of 200 lbs.

See article in this issue of "The Power House" for further description.

Our New Line

TRADE PENBERTHY MARK

REGRINDING VALVES

VIZ.:
Globe, Angle, Cross
AND
Horizontal, Angle, Vertical and Swing Check Valves

Superior in every Feature to those of any other make of valve

THEY EMBODY the newest design and the best mechanical ideas ever employed in **VALVE CONSTRUCTION.**

THEY WILL GIVE absolutely reliable service and dependability under high pressures and severe conditions.

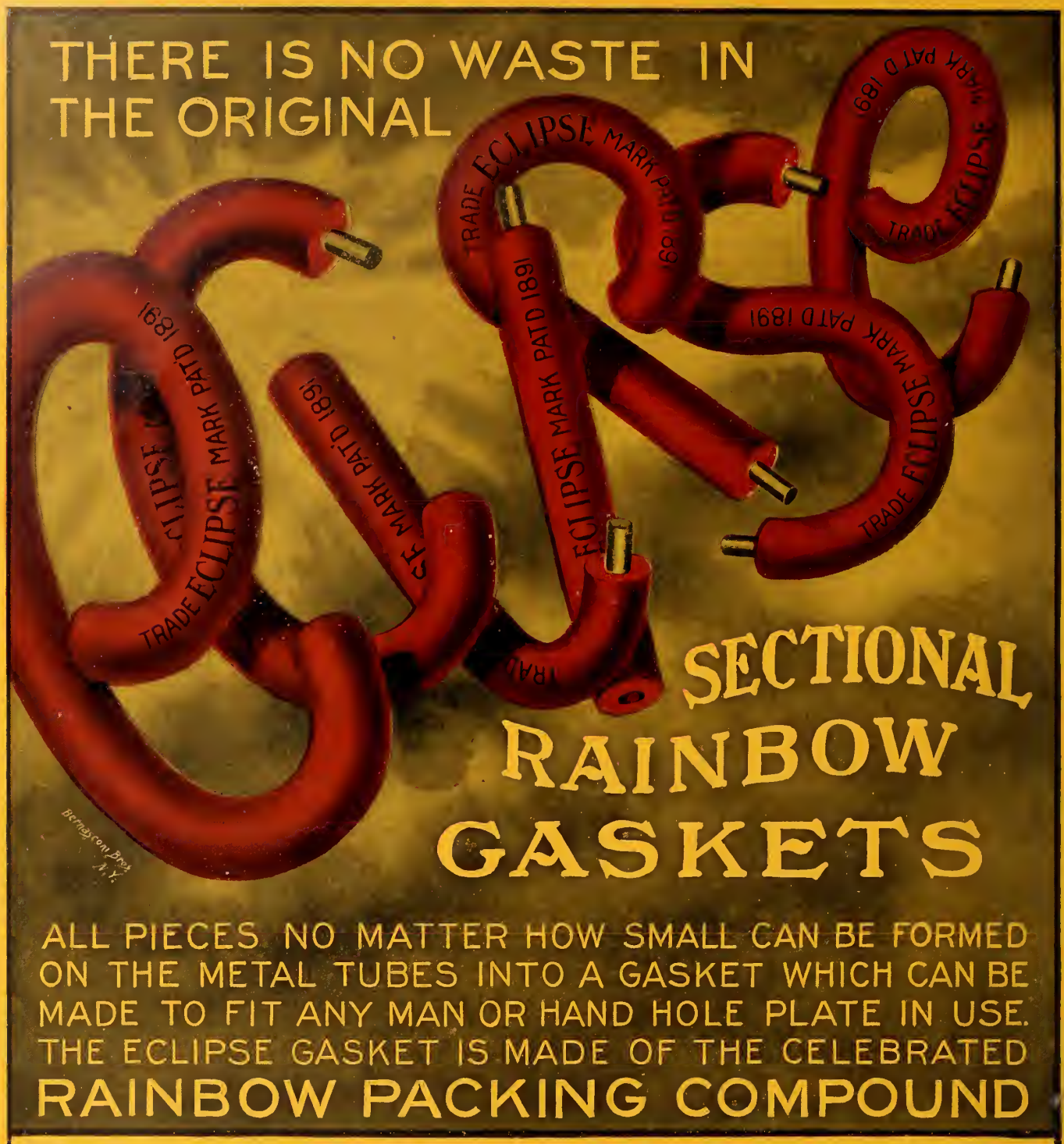
THEY WILL SAVE the necessity of purchasing new discs or seats. **For in the Penberthy Regrinding Valve** no such extra parts are required to repair them if worn, as they can be made as good as new easily and quickly by the simple regrinding method which is impossible in the ordinary valve construction.

Every Power Plant Owner

Who wishes to run his plant to its full capacity in an efficient and economical manner should install **PENBERTHY REGRINDING VALVES.** Write for descriptive booklet.

MANUFACTURED BY

PENBERTHY INJECTOR CO., Limited
Windsor, Ont.


THERE IS NO WASTE IN
THE ORIGINAL
TRADE ECLIPSE MARK PATD 1891
SECTIONAL
RAINBOW
GASKETS
ALL PIECES NO MATTER HOW SMALL CAN BE FORMED
ON THE METAL TUBES INTO A GASKET WHICH CAN BE
MADE TO FIT ANY MAN OR HAND HOLE PLATE IN USE.
THE ECLIPSE GASKET IS MADE OF THE CELEBRATED
RAINBOW PACKING COMPOUND

MANUFACTURED EXCLUSIVELY BY

PEERLESS RUBBER MANUFACTURING COMPANY

16 WARREN ST., NEW YORK.

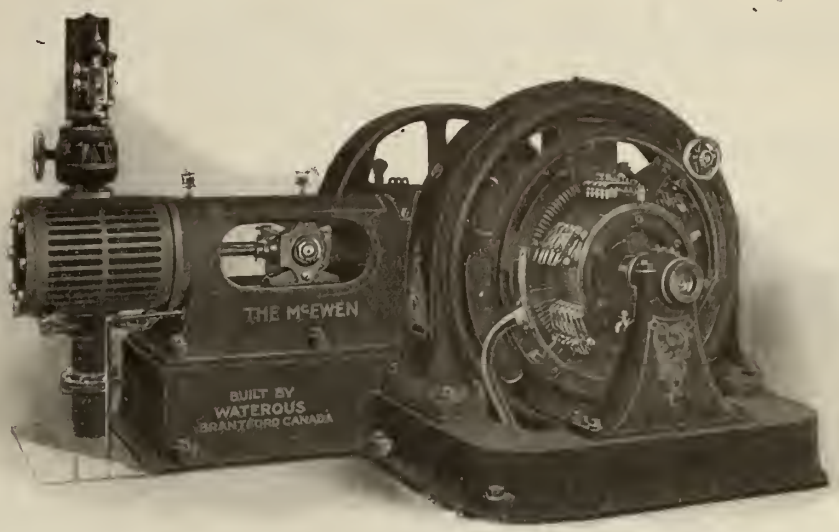
H. D. EDWARDS & CO.

DETROIT, MICH.

Sole Agents and Distributors for the Dominion of Canada.

The advertiser would like to know where you saw his advertisement—tell him.

For the Isolated Plant



The McEwen Engine

Simplicity of operation, economy in steam consumption, and the ability to stand up under hard usage — are features that make the McEwen Engine ideal for Isolated Plant Installation.

Both Simple and Compound types are built. Sizes range from 40 to 700 H.P. These can be arranged for belt drive or directly connected to dynamo as desired. Parts are few, readily accessible for overhauling and cleaning. Best materials only are used, and parts are put together under severe and continual inspection. We stand behind every engine we turn out.

Every McEwen Engine is Canadian built throughout. It is tested and inspected before leaving the works and is backed up by a rock bottom guarantee, that in plain English means "Satisfaction or your money back." Write for booklet for full particulars.

The Waterous Engine Works Co., Limited, Brantford, Canada

BOOKLET ON REQUEST

The advertiser would like to know where you saw his advertisement—tell him.

Sales Over Five Million Dollars Annually

Four Babbitt Manufacturing Plants

TORONTO LONDON, ENG. NEW YORK ST. LOUIS

Faultless "A" This babbitt is a high grade copper hardened alloy, possessing in a higher degree all the good points of the original Genuine Babbitt, with increased antifriction qualities, having the additional merit of absorbing and holding oil. It is used extensively in France for automobile engines, and in South Africa for mining machinery, and in United States and Canada for marine engines, dynamos and all heavy duty machines. Where heavy service is required this will last longer than any Genuine Babbitt manufactured. For heavy duty, saw mills and engines it is without equal.

Eagle "A" Thousands of tons of this alloy have been placed on the market, giving such perfect results, that it's name and merits are known, we believe, as extensively as any other babbitt manufactured. Its high antifriction and heavy duty qualities make it especially adapted for saw-mills, planing-mills, threshing engines, traction engines, pumps, rolling-mills and general machine shop use.

HOYT METAL COMPANY

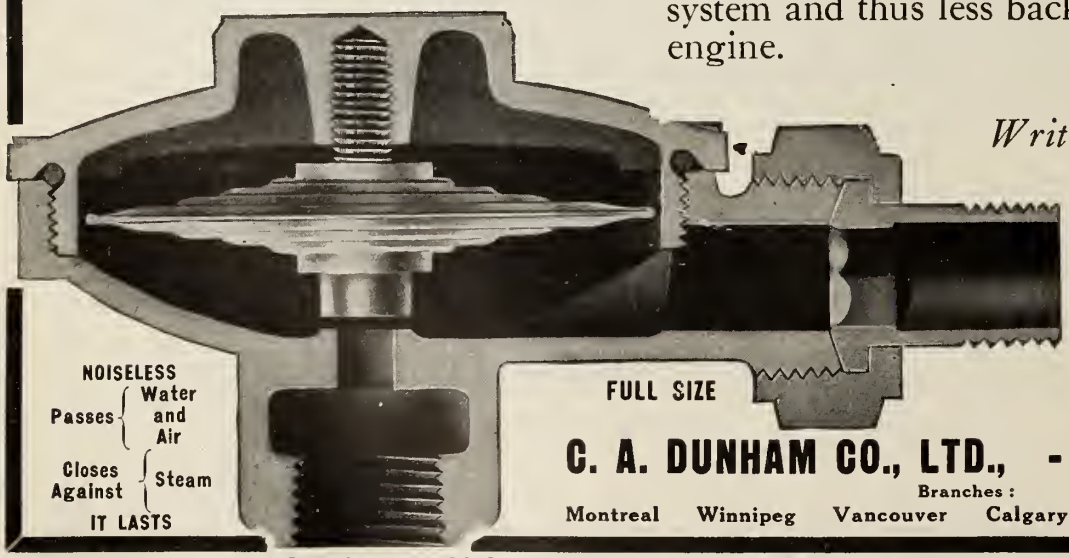
TORONTO OFFICE AND MFG. PLANT—EASTERN AVE. AND LEWIS ST.

Dunham Radiator Steam Traps

Are Saving a great many $'s for the users of them

No steam can possibly waste. All air and water is allowed free passage through trap into return lines, thereby causing radiator to heat up to fullest efficiency. This trap discharging into vacuum returns permit very low steam pressure on system and thus less back pressure on your engine.

Write for Catalog E.
It's Free.



C. A. DUNHAM CO., LTD., - TORONTO, ONT.

Branches:
Montreal Winnipeg Vancouver Calgary Edmonton Lethbridge

The advertiser would like to know where you saw his advertisement—tell him.

JENCKES BOILERS

Horizontal Tubular
Vertical Tubular
Locomotive Types
Heating Boilers
Complete Steam Plants

Why every Progressive Power Plant should use the "JENCKES"

¶ Our Boilers are carefully designed, and the materials used in their construction the best obtainable of their respective kinds.
¶ Flange quality steel, conforming to Manufacturers' Standard Specification, is used in shell and heads. The tubes are lap welded steel of standard gauge and make; the rivets of special quality rivet steel, and the stays of steel, without welds.
¶ JENCKES BOILERS are built to stand severe service, with the least stoppage for repairs.
¶ They are well and favorably known throughout Canada and have been for many years. It is our constant aim to maintain this position in the eyes of all users.
¶ JENCKES BOILERS are built to conform with the various Provincial Inspection Acts. Every one is tested under high pressure before leaving works.
¶ If you want to install a boiler of merit, let us send you full particulars, and connect you with users of JENCKES Boilers in your neighborhood.

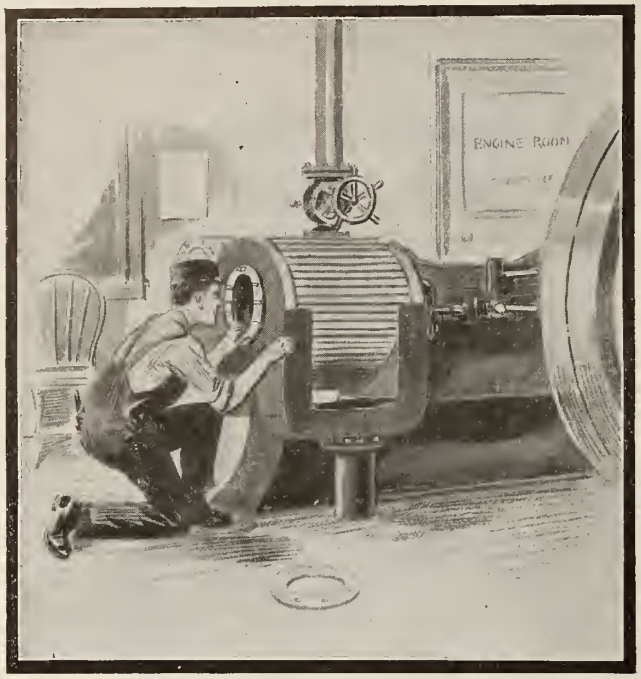
The Jenckes Machine Co., Limited

Sherbrooke Montreal St. Catharines Cobalt South Porcupine Nelson Vancouver

Works: SHERBROOKE, QUE., ST. CATHARINES, ONT.

The advertiser would like to know where you saw his advertisement—tell him.

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY



The Trouble-Saving Packing

Unless you are a user of P. P. P. you know what it means to spend evenings and Sundays in the engine room repacking your engine every few weeks.

Daniel's P. P. P. Rod Packing

is the one packing which automatically adjusts itself to the requirements. The bearing on the rod is never in excess of what is actually needed to keep steam-tight. P. P. P. makes rods as smooth as glass. P. P. P. lasts for months, in many cases over a whole year. Order from your dealer.

When Something Goes Wrong Inside

The chances are you will find the quick means of setting any trouble right, if you have a copy of the Valve Book we offer, FREE, to engineers. This handy volume tells all about the SLIDE VALVE and a lot of other things every engineer needs to know.

No book will be sent unless the coupon is completely filled out and returned to us.

How To Get The Valve Book FREE

Fill out the Coupon, and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and look at Daniels' P. P. P. Packing.

Your Name .....
Address .....
Employed by .....
Address .....
Horsepower of Engine .....
Kind of Rod Packing Used .....
Do you use EBONITE Sheet Packing? .....
Dealer's Name .....
Address ..... Series 24-K-V
Name of Buyer .....

If your dealer doesn't carry P. P. P. we will write telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

FREE to Users of P.P.P.

If you are a user of P. P. P., fill out the coupon and mail it to us with the Big Red D—cut from the box lid—and a **testimonial letter** of your experiences with the packing. We will then mail you a FREE copy of "The Slide Valve" direct. You'll not be required to go to your dealer for the book. Don't forget the letter.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods
PHILADELPHIA, PA., U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

TRADE THE GARLOCK PACKING CO. HAMILTON, CANADA. MARK

GARLOCK PACKINGS

On account of their superior qualities, are recognized as a standard packing for use under all conditions of service. Our Trade-mark is the passport by which we are known to those in need of reliable goods.

We have Packings to meet every requirement, and all you have to do is to write for information.

Garlock High Pressure Ring

Our handsomely illustrated catalog, descriptive of Garlock Packings and Pipe Coverings will be mailed on request.

Garlock Asbestos Gasket

"POINEERS IN THE PACKING BUSINESS."

The Garlock Packing Co.

Head Office and Works: HAMILTON, ONT.

Branches: MONTREAL, QUE., 412 St. James Street.
TORONTO, ONT., 77 Adelaide Street East.
WINNIPEG, MAN., 117 Market Street East.

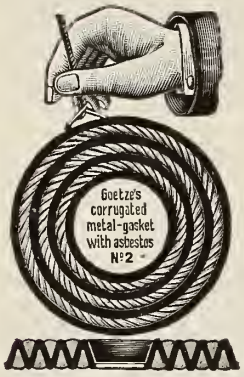
GOETZE'S VALVE GASKETS SAVE TROUBLE AND MONEY

THEY ARE FOR VALVES OF THE JENKINS TYPE
AND ARE MADE OF COPPER AND ASBESTOS

One Goetze's Valve Gasket will outlast six rubber discs, because it will not crack and go to pieces as rubber does. That's why Goetze's Valve Gaskets are cheapest from beginning to end.

Order your new valves fitted with Goetze's Valve Gaskets and have no more trouble with leaks. Use Goetze's Valve Gaskets to give your old valves a new lease of life. Only be sure you get *Goetze's.*

That Joint That Gives You So Much Trouble Can Be Made *Tight*



To put a gasket on the least troublesome flange joint in your plant is no real test of the value of that gasket. Put it on the *worst* joint, the one that is always giving you trouble, and you'll find out whether it is any good for your purpose or not.

We tell you that you can put a complete stop to all trouble due to leaky flange joints, that you can make that joint which gives you so much trouble absolutely tight

By Using Goetze's No. 2 Gaskets

And we are willing to prove it to you by shipping you any quantity on *90 davs' trial*—no charge if they do not make tight joints and *hold* them tight under all pressures and temperatures. Try them. Write us to-day what sizes and quantities to ship. Remember, they do not cost you a cent unless they do the work. And be sure to ask for a copy of our Illustrated Catalog of Packings for all Power Plant Purposes.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

St. John, N.B.

BRANCHES AT

MONTREAL
70 Cedar Ave.

WINNIPEG
C. E. Chown, 147 Bannatyne Ave.

VANCOUVER
A. O. Campbell, 1069 Hamilton St.

MANUFACTURED BY

Goetze Gasket & Packing Co.

NEW BRUNSWICK, N.J.

SEAL OF QUALITY

TRADE MARK

This mark is the assurance of the highest quality. It is known all over Canada as the emblem of reliability and economy.

DUNLOP

Piston Rod Packing

Before Pressure

is composed of two wedges and a yielding absorbent cushion. The wedges are so formed that they will freely slide on each other, compensating for the wear made by the rod or unevenness of the rod or box. The Packing absorbs all Oil that may be put on the rod or fed to the box by other means, and lets it down evenly and regularly. This combination makes a soft, pliable packing, and when properly applied prevents the rod from binding or heating.

Under Pressure

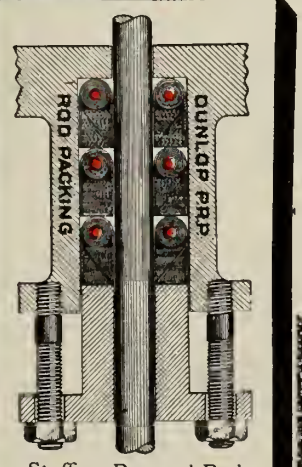
"DUNLOP" Piston Rod Packing is extremely elastic under all conditions, and by its use is assured the minimum amount of friction. It is self-lubricating, and will not become hard.

It is impervious to the action of steam, acids, alkalies and sulphurous waters, and eliminates the loss of Ammonia in the ice-making machine.

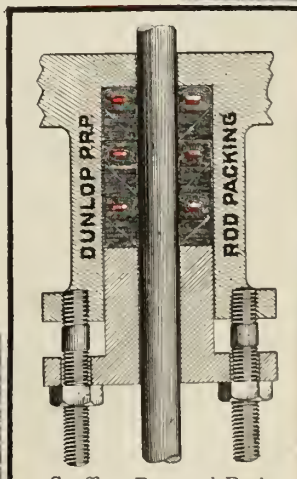
It works equally well on a heavy pump as on the most sensitive valve stem.

Cannot be affected by vibration of rod.

Try "DUNLOP" Piston Rod Packing and be convinced that all we claim is true.



Stuffing Box and Rod with Packing in, and gland adjusted.



Stuffing Box and Rod showing Packing under Pressure

Dunlop Tire & Rubber Goods Co., Limited.

Head Office and Factories: TORONTO

Branches: Victoria, Vancouver, Nelson, Edmonton, Calgary, Regina, Winnipeg, London, Ont., Hamilton, Toronto, Ottawa, Montreal, St. John, N.B.

TRADE JENKINS MARK
Jenkins Bros

Here's a Catalog

You Ought

to have—

The new

Jenkins Bros.

Catalog for 1912

It shows some new types of valves, including the new TYPE "K" brass and iron body gate valves; cast steel valves of extra heavy patterns for superheated steam and hydraulic service, extra heavy check and blow-off valves, automatic equalizing stop and check valves, additional styles of radiator valves—

As well as the standard Jenkins Bros. types you have known and used for years.

Compact—handy—brimful of information for the man who's interested in valves, packing and other mechanical rubber goods for the power plant.

Send for your copy to-day.

Jenkins Bros., Limited

103 ST. REMI STREET

MONTREAL

LUNKENHEIMER SUPERIOR STEAM BOILER VALVES AND FITTINGS

CONFORM WITH CANADIAN BOILER REGULATIONS AND ARE APPROVED FOR USE IN WESTERN CANADIAN PROVINCES, INCLUDING BRITISH COLUMBIA, ALBERTA AND SASKATCHEWAN.

The line approved includes globe, angle, cross, check, non-return safety boiler stop, gate, blow-off and pop safety valves, water gauges, gauge cocks, etc.

A complete list of official registration numbers covering the above will be sent upon request.

The supremacy of LUNKENHEIMER PRODUCTS is universally acknowledged, and to maintain this reputation, the highest type of skilled labor is employed and only new material of the very best grade is used.

We guarantee our goods to be of the very highest quality, and a LUNKENHEIMER GUARANTEE is a real, definite quantity and not an empty use of the meaning of a guarantee.

All correspondence and inquiries receive prompt attention, and immediate shipments are assured, as large stocks are carried.

Our products are carried in stock by most supply houses. Those that do not carry them can get them for you, but if they will not, write us.

WRITE FOR 1912 CATALOGUE.

THE LUNKENHEIMER COMPANY

Largest Manufacturers of High-Grade Engineering Specialties in the World.

GENERAL OFFICES AND WORKS:
CINCINNATI, OHIO, U. S. A.

NEW YORK, 64-68 Fulton Street.
BOSTON, 138 High Street.
CHICAGO, 186 North Dearborn Street.
LONDON, S.E., 35 Great Dover Street.

32-43

Ventilating a Valuable Fact

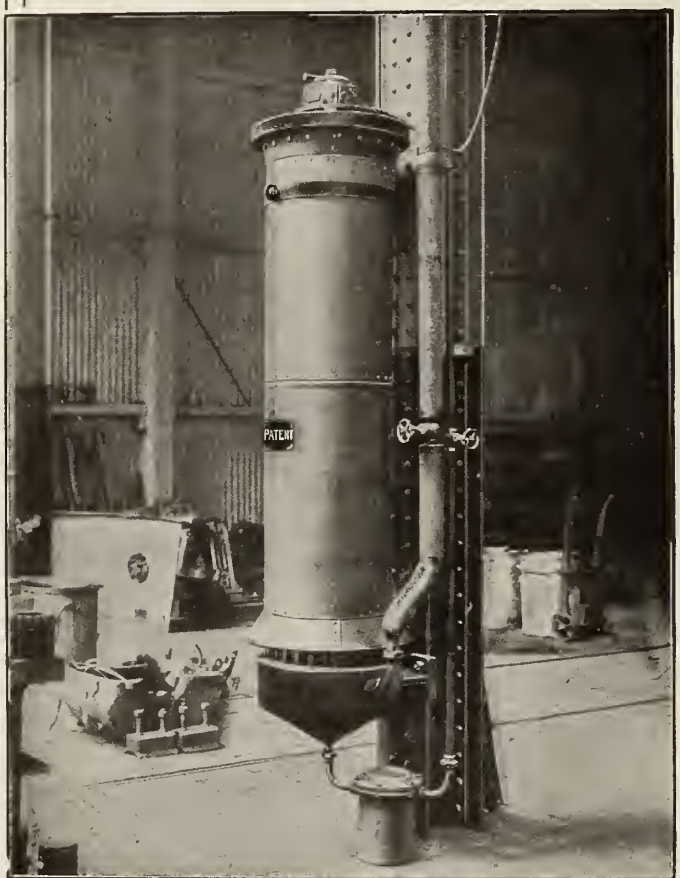
A Subject of Vital Importance to Your Business

It is a well established fact that a man working in a properly heated and ventilated shop can accomplish far more than the same man working in a poorly heated and ventilated shop. He can do more, and do it better, and stands a bigger chance of doing it day in and day out.

THE STANLOCK SYSTEM

of Heating and Ventilating

Inexpensive at the start and completely satisfactory in use. Adopted by many leading engineers and big manufacturers in this country and Europe.



The System

This system consists of units as shown below. They are made of steel tubes screwed into circular cast iron bases and through these tubes steam passes. Enclosing these tubes is a sheet metal cylindrical casting with a motor at the top. The air is forced downwards, thus keeping the floor warm. A special pipe can be fitted, passing through the roof or through the side wall, thus giving a supply of fresh air. Dampers are provided so that the inside air can be circulated or outside air can be taken in and heated. Can be installed in old or new buildings.

Its Advantages

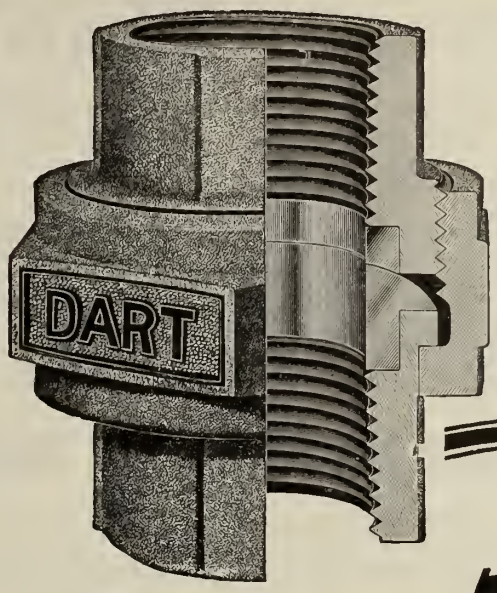
1. No overhead air ducts are required.
2. No underground masonry ducts are required.
3. No obstruction to light due to overhead air ducts.
4. No heat losses due to radiation from air ducts.
5. Minimum of power absorbed.
6. Units hung on walls. No floor space needed.
7. Various units operated independently and can be turned on or off like radiators. Some supply fresh heated air and others merely circulate and heat.
8. A unit using 60 lb. steam pressure heats 3,600 sq. ft. of floor space.
9. The first cost of apparatus is very low.
10. Units may be added at any time in case of extensions, and in case of boiler shops, units may be removed entirely during the summer months, if desirable.

IT WILL PAY YOU TO ASK US FOR COMPLETE INFORMATION AND AN ESTIMATE ON YOUR REQUIREMENTS. DICTATE A LETTER TO-DAY

THE GARTH COMPANY

Sole Canadian Agents

26-32 Craig Street, Montreal



UNION SERVICE

The "Dart"

Union pipe coupling has, in the twenty years it has been in use, proven that it is the union of the highest efficiency.

With them connections are easily made, whether pipes are in or out of line.

The connection stays tight until deliberately loosened. Then the union is as serviceable as when new.

They not only positively prevent all loss and expense that would come with leaks, but they eliminate the replacement costs.

You get maximum service from every Dart Union and you are guaranteed it, for any union bearing our trade mark that does not make good, will be replaced two for one.

Both sections of the Dart are seated with solid non-corroding bronze, machined and ground to a true ball joint. The iron thread ends are unusually heavy to prevent all stretching or pulling apart. Expansion, contraction, vibration or corrosion will not affect them.

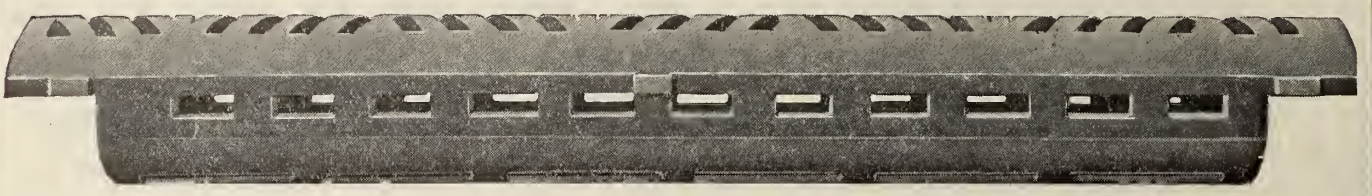
Made in all convenient forms—flanged, tees, elbows, etc., male or female, and Jobbers throughout Canada sell them.

Dart Union Co., Limited

TORONTO CANADA

Your Steam Supply **LOW** and Coal Bills **HIGH?**

THOMAS ELLIPTIC GRATE BARS



INCREASE Steam Supply, DECREASE Coal Bills.

Cost Less by Lasting Longer. Make more Steam by Increasing Combustion.
Save Fuel by Better Burning the Gases. Save Labor by Reducing Fuel and Cleaning.

KILBY FROG & SWITCH CO.

Birmingham, Ala., August 12th, 1912.

Thomas Grate Bar Co., Birmingham, Ala.

Gentlemen: We have been using the "Elliptic Grate Bars" continuously for the past year, and they are giving us the best of satisfaction. We have not had occasion to renew these bars since we first installed them, and find, after careful watching, they are far superior to the old style bars, not even shown any signs of deterioration since installation.

We heartily recommend them unreservedly to any firm or corporation wanting high grade bars, as they reduce the cost of coal to a minimum.

Yours truly,
KILBY FROG & SWITCH CO.,
(Signed) C. H. Krauss, Superintendent.

WOODWARD LUMBER COMPANY,

Augusta, Ga., August 16th, 1912.

Hickman, Williams & Co., Birmingham, Ala.

Gentlemen: Answering your letter of the 15th, in regard to Thomas Grate Bars, beg to say that we could not give you, with any degree of certainty, the percentage of fuel saved over the old grate bars, as we have never given this matter a practical test. We burn shavings in two of our boilers and R.M. coal in the third; in both instances the bars are very satisfactory, as a matter of lasting qualities, they are beyond anything we have ever used. This particular feature led us to make our first purchase of Thomas Grate Bars, and we find that they will last two or three times as long as any other grate bar we have ever used, thus saving a great deal in renewal.

Yours very truly,
WOODWARD LUMBER CO.
(Signed) J. C. LEE, President.

Solving others' STEAM troubles, WHY NOT YOURS?

Write to-day for STEAM TROUBLES FOLDER

The General Supply Co. of Canada Ltd.

OTTAWA, TORONTO, WINNIPEG.

Thomas Grate Bar Co., Birmingham, Ala., U.S.A.

You Can Burn the Cheapest Grades of Fuel

by installing

"THE Cyclone"

Shaking and Dumping Grate Bar

And Procure Results Equal to that of the Best

The Echo Milling Company, Limited,
Gladstone, Man. Oct. 17, 1912.

The Canadian Steam Boiler Equipment Co., Limited,
Toronto.

Gentlemen:—

Enclosed please find cheque to cover invoice for two sets of Cyclone Grates. We were late in getting started up, but have had them in use 2 weeks, and are satisfied that they are all you claim for them. Kindly receipt account and return. Yours truly,

Echo Milling Co., Ltd.

The Echo Milling Company, Limited,
Gladstone, Man. Oct 28, 1912.

The Canadian Steam Boiler Equipment Co., Limited,
Toronto.

Gentlemen:—

We have yours of the 21st, and in reply would say that we have no objection to you using ours of the 17th, as a testimonial, if you think it will do you any good.

We shall only be too glad to give your grate bar a good word with any intending buyer, as our engineer says the only fault he has to find that we did not put them in sooner. We are yours truly,

Echo Milling Co., Ltd.

The money that you are now losing through not having the "Cyclone" will pay its cost in a very short time.

This Grate Bar has been on the market for years and has been endorsed by all users as the best they have ever used.

The *"Cyclone"* has proved that it guarantees more steam from less fuel than any other.

The Cyclone Bar is built to get rid of the ash. *It has an improved mechanism,* which means more vigorous and effective shaking and prevents any ashes or clinkers from clinging to the centre of the grate.

Its construction allows 68 per cent. air space and 90 per cent. under draft and gives a perfect combustion.

Beware of Imitations

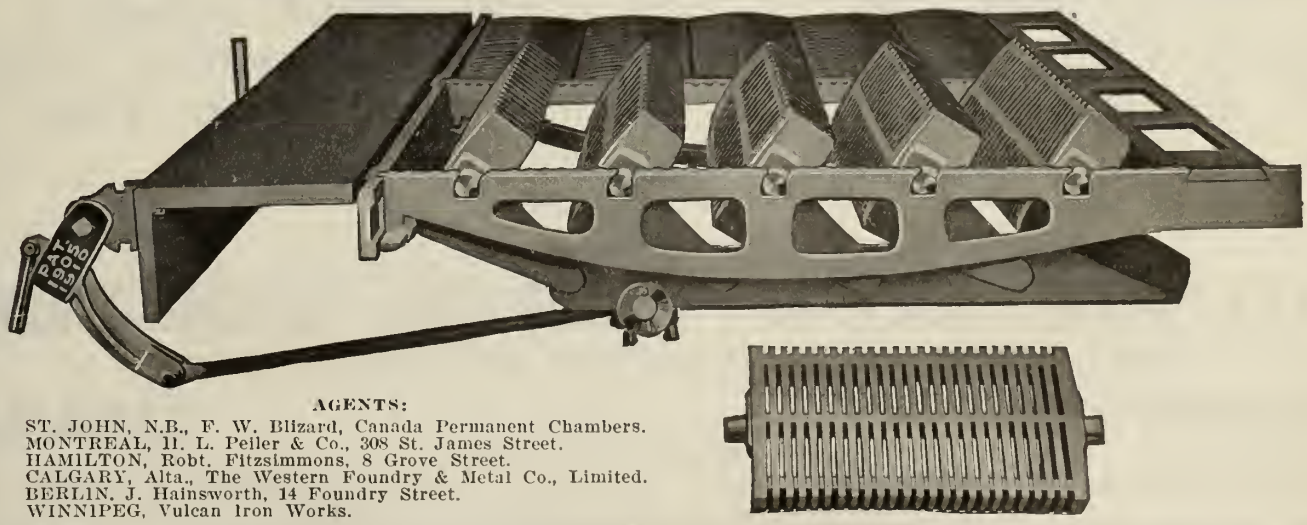
Their grates are constructed like ours, but are inferior in quality and efficiency.

Write for our descriptive booklet to-day, and get full particulars.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST :-: :-: :-: TORONTO, CANADA



AGENTS:

ST. JOHN, N.B., F. W. Blizard, Canada Permanent Chambers.
MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street.
CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street.
WINNIPEG, Vulcan Iron Works.

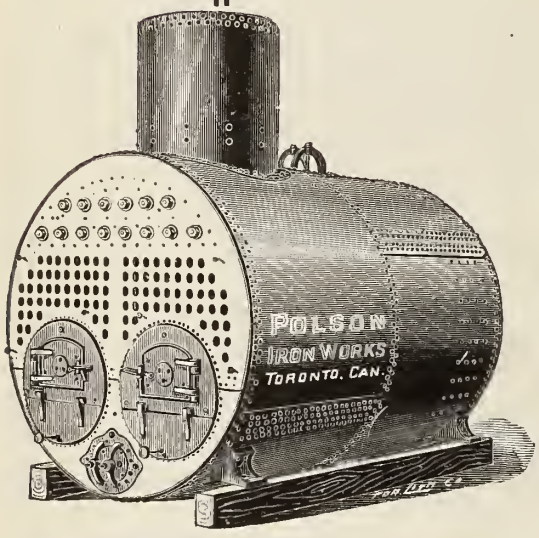
The advertiser would like to know where you saw his advertisement—tell him.

MARINE BOILERS

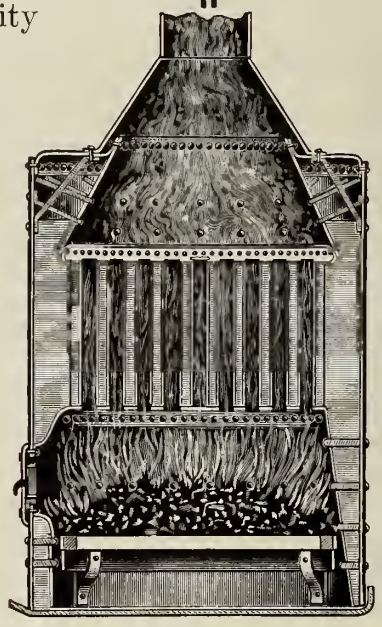
LAND BOILERS

The Utmost in Boiler Efficiency

From start to finish these boilers are under the supervision of experts, and are made by men with long experience. Only the best materials are used, so as to ensure a boiler of unusual durability and safety.



It will pay you to communicate with us and get full particulars. You may need a new boiler soon, and you will want the best.



We build various types:

Scotch, Clyde, Fitzgibbon, Vertical, Mosher.

Horizontal Tubular, Vertical, Locomotive Type, "Heine" Water Tube

GENERAL PLATE WORK

POLSON IRON WORKS, LIMITED

STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

TORONTO **CANADA**

REPRESENTATIVES IN CANADA FOR

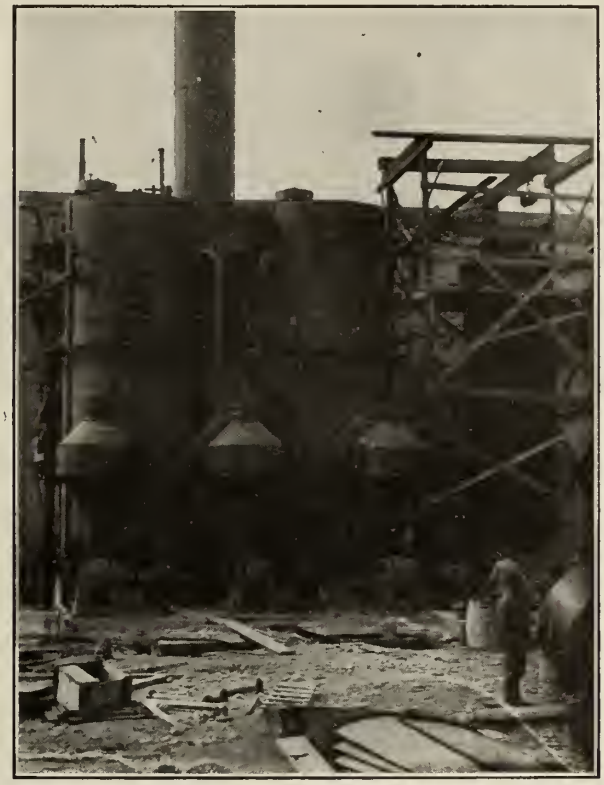
The B. F. Sturtevant Co., Hyde Park, Mass., U.S.A., Fans, Blowers, Heating and Ventilating
The John I. Thornycroft Co., London, England, Marine Motors

BETTINGTON BOILERS

How much does it cost you for steam?
How much fuel remains in your ash?
How much unconsumed volatile is going up your stack?
If you are burning slack coal are you obtaining the maximum evaporation from it?

REASONS WHY THE BETTINGTON SYSTEM WILL CUT DOWN YOUR FUEL BILLS.

1. Analysis of the ash shows no carbon.
2. Volatile is all consumed.
3. Cheap coal containing as high as 35% ash can be burned with the highest efficiency.
4. Stand by losses eliminated.
5. The cheapest grades of coal can be used.
6. Less labor required.



Bettington Boilers in course of erection for Dominion Coal Co., Ltd.

OPERATING ADVANTAGES OF THE BETTINGTON SYSTEM.

1. No grates.
2. No fires to clean.
3. Less ash to handle.
4. Fuel supply quickly adjusted to demand for steam.
5. No smoke.
6. No stand by boilers with banked fires necessary to take care of peak loads.
7. Full load can be obtained in 30 minutes from a cold boiler.

THE BETTINGTON SYSTEM of burning pulverized fuel gives all the advantages of gas fired boilers, and 80% thermal efficiency with the cheapest fuel can be continuously obtained.

FRASER & CHALMERS
LIMITED

Canadian Branch:
4 PHILLIPS PLACE, - - MONTREAL, P.Q.

Eight Reasons Why

You Should Make A Practice of Using

(1) Eclipse is perfectly harmless to boilers and their fittings.

(2) Eclipse keeps boilers entirely free from scale by depositing the scale forming particles as mud.

(3) Eclipse forms a filmy enamel upon the heating surfaces, which is a sure protection against pitting and corrosion.

(4) Eclipse neutralizes the effect of oil and grease; it also prevents priming.

(5) Eclipse softens and removes old scale.

(6) Eclipse is cheap to use, because only a very small quantity is required.

(7) Eclipse acts in the same way in all waters, because its action is mechanical.

(8) Saves an enormous amount of fuel.

W. W. CARRUTHERS

450 Edmonton Street, WINNIPEG, MAN.

Sales Agents for Ontario—M. McEACHERN, 131 Montrose Ave., TORONTO

The advertiser would like to know where you saw his advertisement—tell him.

WE GUARANTEE

Walker's Electric

Boiler Compound

TO ERADICATE ALL SCALE

You will get your money back if you are not convinced that it decreased your Fuel Bill.

We also guarantee that it will keep scale from forming if used regularly, that it will not injure your boilers, fittings or pumps in the slightest—that it will increase your boiler capacity and efficiency — that it will prevent pitting or corrosion or other boiler troubles due to impurities in the feed water.

Send us a sample of your feed water for analysis and get our prices.

Try a barrel — if it does not come up to our guarantee, ship it back at our expense.

You cannot afford to overlook this trial offer.

We also manufacture the following High Grade Oils:

Regal Valve Oil, Red Star Cylinder Oil, Monarch Cylinder Oil, Heavy Red Machine Oil, Superior Engine Oil, Electric Engine Oil, Brush Dynamo Oil, Auto Carbon Auto Oil.

It will pay you to give them a trial.

The

Electric Boiler Compound Co., Ltd.

Guelph, Ontario.

SAVE 50%

By Using
GREASE AS A LUBRICANT
In The

"PHILADELPHIA" GREASE CUP

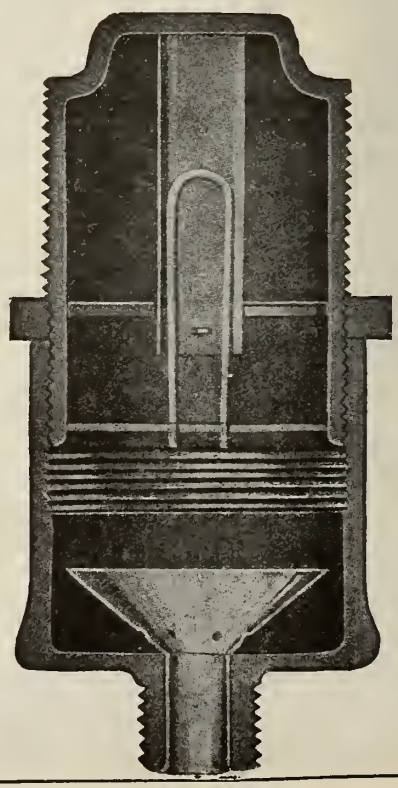
Automatic Feed Under Compressed Air
Slow And Continuous
No Oil Drips—Reduced Fire Hazard

Unexcelled for Lubricating Loose Pulleys, Crank Pins and all classes of Extremely High Speed and Heavy Running Machinery.

In the "Philadelphia" Grease Cup System of lubricating there is no friction, no piston or spring is used, just a thin metal disc resting lightly on the grease to keep it level.

Air pressure above and the needs of the journal below are all that is required to give perfect lubrication. Grease does not change in the slightest, while in the "**Philadelphia**" **Cup**; the last drop is as good as the first.

There is a large unrestricted outlet and a regularity of action which permits feeding of grease of any thickness.



We guarantee a saving of at least 50% over any other system. You must be perfectly satisfied before you pay a cent.

Our Booklet tells more about it — write to-day.

Peterborough Lubricator Mfg. Co., Limited

PETERBOROUGH, ONTARIO

0.00080
A RECORD BREAKER

The above figures have nothing to do with baseball or horse racing or any other line of sport, but represent a record made by MAGNOLIA METAL in a test by UNCLE SAM.

These figures are furthermore vouched for and **made authentic** by being recorded in the Annual Report of the Secretary of the Navy for year 1888—pages 397 to 410 inclusive.

Three expert Naval Engineers spent weeks testing MAGNOLIA, and the results were so favorable that they recommended its use by the Steam Engineering Department of the Navy.

The above figures represent the wonderfully low frictional co-efficient obtained in the **Water** test. They also tested with Sperm Oil. The records show:

Sperm Oil Test	—550 lbs. pressure per square inch,	495.73 R.P.M.
	Co-efficient of friction	0.0011875
Water Test	—300 lbs. pressure per square inch,	491.87 R.P.M.
	Co-efficient of friction	0.00080

It is doubtful if such low frictional co-efficients were ever before obtained in any test of babbitt metals.

Very likely you are like most mortals, well posted on many kinds of records useful and useless, and we would like you to add these figures to your fund of information, because they represent records worth remembering. Please, also, bear in mind that a babbitt having such a low frictional co-efficient, wears longer, absorbs less power, requires less lubrication, cheaper oils can be used, less metal is needed, cost of frequent rebabbitting is saved, the coal pile lasts longer, and it gives the Engineer rest and peace of mind. Why not cast off the shackles of high-priced or inferior metals and add to the efficiency of your plant by using MAGNOLIA METAL?

SPECIAL OFFER.

PRACTICAL ENGINEER POCKET BOOK: 700 pages, over 2000 subjects. Price 40c. post paid. We import these books, in large numbers, from England, as an advertising medium and give Engineers the benefit of low price. They are highly spoken of.

Address Montreal Office.

Sold by leading Dealers everywhere or by

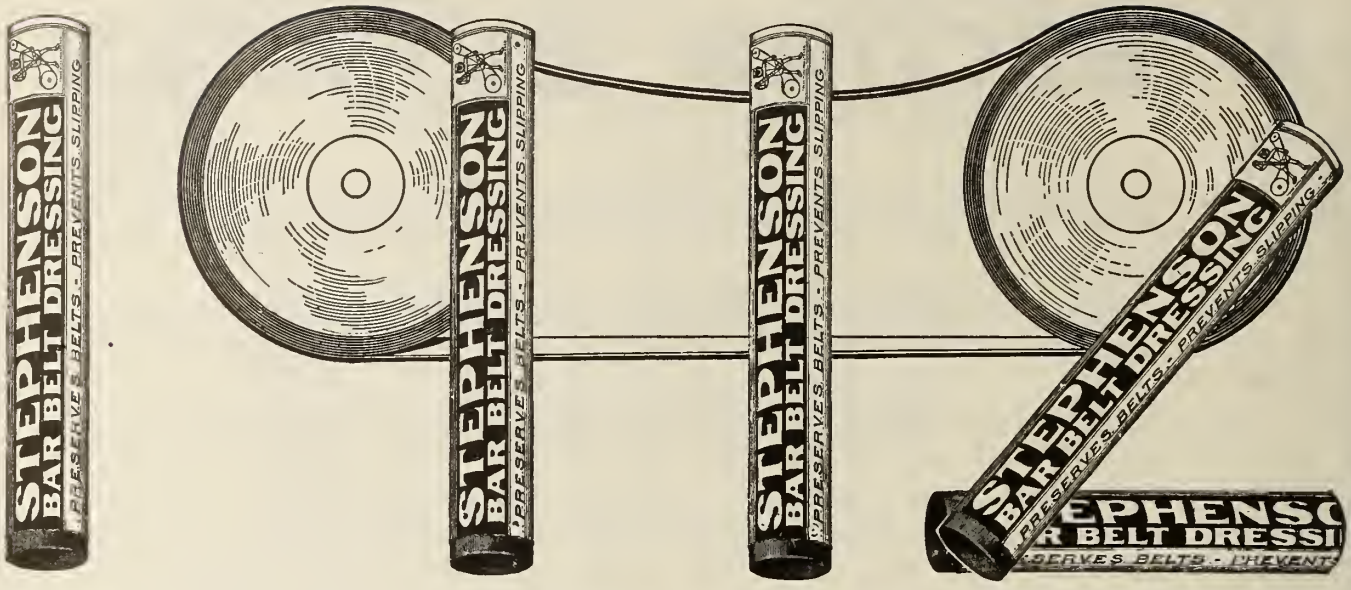
Magnolia Metal Co.

OFFICE AND FACTORY:

225 St. Ambroise St. MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.

For



Use Stephenson Bar Belt Dressing

Make 1912 a record breaking year. Turn over a new leaf and get rid of the things that have been causing needless trouble and expense. Adopt the things which will make your work easier, give better results and save money for your employer. You cannot start at a better place than with your belt dressing.

Get rid of your troublesome liquid dressing. Shake the can for the Stephenson solid stick and shake trouble at the same time.

Stephenson Bar Belt Dressing is a friend in need. It doesn't require preparation, nor do you have to use special care in applying it. The minute the belt slips you hold the Stephenson bar to the belt for a few seconds and the slipping stops. There's no waste—no slop—no smearing on of paste or pouring on of spattering liquid. And the results are better.

I'll "Stick to the Solid Stick"

Start With a Free ½ Lb. Sample

Simply send us your name and address and we'll send you a present in the shape of a free half-pound sample of Stephenson Bar Belt Dressing.

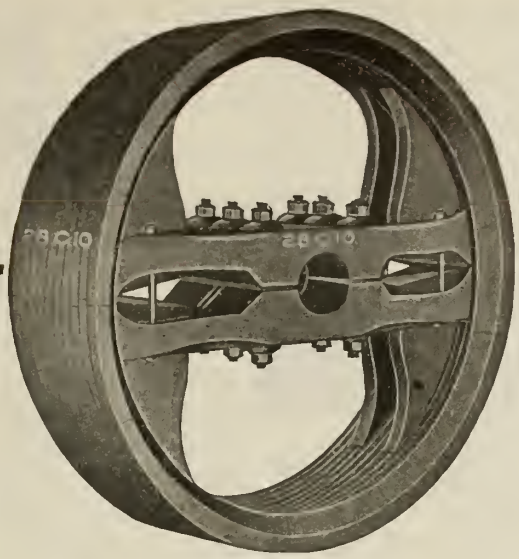
Remember—we give you this sample absolutely free of charge. Get this free half-pound of the finest belt dressing made and test it. Here's your chance to try somesomething really good at no expense.

None Genuine Without Trade-Mark

Stephenson Manufacturing Company

Est. 1888 Albany, N.Y. **Inc. 1897**

The advertiser would like to know where you saw his advertisement—tell him.



For Power Transmission

Use Fairbanks

Wood Split Pulleys

These Pulleys are the result of years of experience in the manufacture of Wood Pulleys. They embody many excellent features and are conceded to be in every mechanical detail, the most perfect Wood Pulley made.

The arms are made of birch in varying numbers of sections according to the width of the pulley, and are clamped to the shaft by through bolts.

A special feature of construction which makes these pulleys the peer of all others and overcomes the inherent objection to Wood Pulleys, i.e., the separating of the rim from the arms, is the web. This web is mortised into the arms and rim, securely holding the whole pulley together.

The Rims and also the Webs are made of thoroughly seasoned bass wood, as it will transmit 25 to 60 per cent. more power than any other. The Rim is built up in segments or "lags" about 6 inches long. Every layer breaks joints with the preceding layer and each segment is nailed to the others by triple coated nails. These nails are triple coated to prevent them from pulling out and as a protection against dampness, oil, etc.

Each pulley is covered with several coats of special water-proof varnish, which forms an excellent surface for the belt.

These pulleys are bored to a standard and have a complete system of interchangeable Wood Bushings, one set of bushings furnished with each pulley.

ASK FOR CATALOG No. 17

The CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

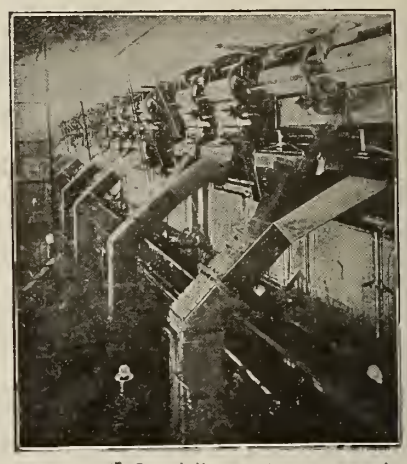
SCALES, VALVES, GAS ENGINES, PUMPS, RAILWAY AND CONTRACTORS' SUPPLIES, ETC.

Montreal, St. John, Ottawa, Toronto, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

A busy paper mill making cheap steam without smoke, smuts or grits by the use of "Bennis" machine stokers.

Cheap Steam for Industrial Undertakings

There are many Paper Mills that are paying too much for their steam. With heavy fuel bills the boiler-duty is low and the boiler unable to respond rapidly to varying demands. Added to these troubles is that of a smoky and gritty chimney, the emission of smoke proclaiming imperfect combustion. "Bennis" Machine Stokers and Self-cleaning Compressed Air Furnaces reduce the coal bill, increase boiler-duty without detriment to the boiler, meet easily demands for rapid steam raising, maintain absolutely smokeless chimneys, and effect an all-round saving that makes their installation an investment.



A range of "Bennis" machine stokers increasing the steam output of water-tube boilers, and preserving boiler-life.

Write for **"Boiler-house Economy in Industrial Undertakings"** pamphlets, and full particulars to

GEO. H. TOD, 213 Manning Chambers Queen St. West **TORONTO**

6″ Flanged End Kerr Gate Valve

When next you order an Iron Body Gate Valve, Specify

Kerr's New Pattern

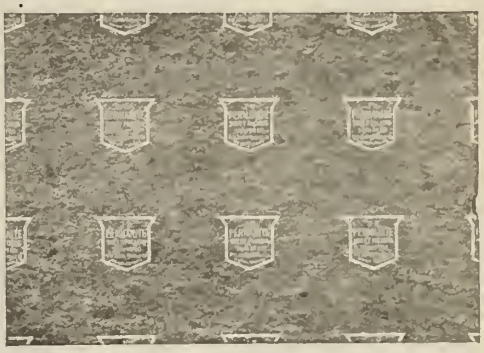
LIKE THIS ILLUSTRATION

We want you to see and try what we know to be the strongest and best made Valve on the market for Standard Pressure. Every Valve tested 300 pounds Hydraulic Pressure.

THE KERR ENGINE CO., Limited

WALKERVILLE, ONTARIO

J-M Permanite Sheet Packing
Makes Things Easier For The Engineer



It's up to you, Mr. Engineer—so far as power is concerned—to see that things run smoothly.

And you'll find J-M Permanite Sheet Packing a mighty big help to you there.

If you use this packing on all joints, you'll never have any men or machines standing idle on account of leaky joints.

J-M Permanite Packing will eliminate a lot of vexatious delays, shut-downs and tie-ups.

And you won't have to come around on Sunday morning to follow up this packing.

It makes a permanent leak-proof joint even on rough or uneven surfaces. Never blows out, burns out nor squeezes out.

It is made of the highest grade of Asbestos—a fireproof mineral. So it will withstand the highest temperature.

And it is resilient and pliable, adjusts itself to any unevenness—no tinkering necessary in fitting it.

J-M Permanite Packing lasts, on an average, about three times as long as ordinary packings. A big economy in the end. And it is cheaper to begin with than most other packings because of its lightness in weight—more packing per pound.

Hasn't an equal for packing cylinder heads, steam chests, pipe flanges, or any other joint which has to hold super-heated or saturated steam (high or low pressure) water, air, ammonia, sugar solutions, alkali or acidulated solutions. To prove that at our expense, we ask you to write nearest branch for free sample—try it on the most troublesome joint in the plant, then judge for yourself.

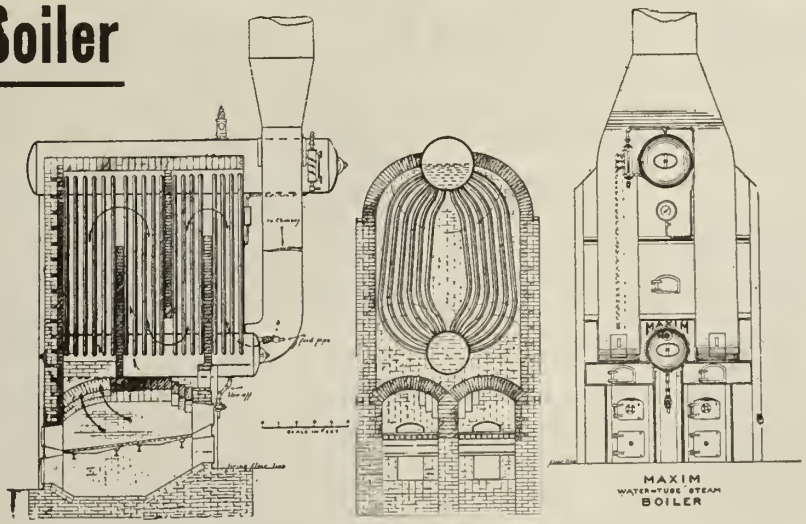
Write now for sample and booklet.

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED

Manufacturers of Asbestos and Magnesia Products — TRADE ASBESTOS MARK — Asbestos Roofing, Packings, Electrical Supplies, Etc.

TORONTO MONTREAL WINNIPEG VANCOUVER

The Maxim Boiler



Do you understand the purpose of a feed water heater? Well, have you used an economizer? If your boiler carries steam at 100 pounds pressure, the temperature of the steam (and therefore the water in the boiler) is 338 degrees. If you get your waste gases down to 500 degrees you are doing well. This is where an economizer comes in. The waste gases are carried through it and their temperature reduced, maybe by 150 degrees. The feed water is passed through the economizer, going in at maybe 80 degrees and out at 200. THE MAXIM BOILER INCLUDES AS ONE OF ITS PARTS AN ECONOMIZER, and we have cases where the owners report the flue gases reduced to below 300 degrees.

THE ALISON ECONOMIZER IS ARRANGED AS PART OF THE MAXIM BOILER. It is the most effective economizer made. It makes the Maxim Boiler more economical than any other.

Report of test of two 250 H. P. Maxim Water Tube Boilers at works of the Keystone Watch Case Co., Philadelphia:

Average Temp. Feed Water, 62.5 degrees Fahr.

Average Temp. of Steam, 357 degree Fahr.

Average Temp. Escaping Gases, 312 degrees Fahr. Highest, 370 degrees, Lowest, 280 degrees.

Fuel, No. 2 Buckwheat or Rice Anthracite.

Quality of Steam, 99.5 per cent. dry.

EQUIVALENT WATER ACTUALLY EVAPORATED FROM AND AT 212 DEGREES PER POUND OF COMBUSTIBLE, 12.177 LBS.

The above test was made by the owners of the plant.

Maxim Tubes do not work loose, and Maxim Boilers make better use of the fuel than is possible with other boilers. MAXIM BOILERS ARE ECONOMICAL ALL THE TIME.

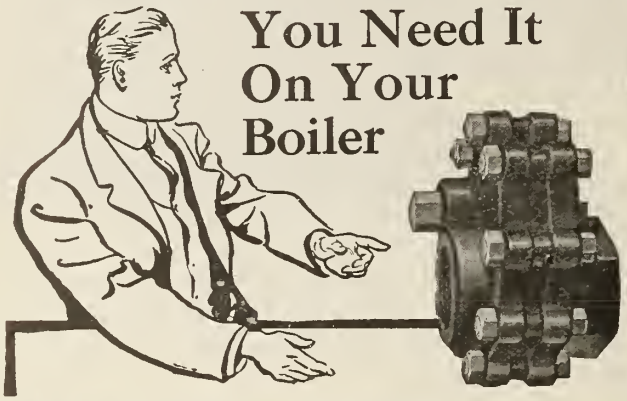
Ogilvy Engineering Company, Bank of Ottawa Building, **Montreal**

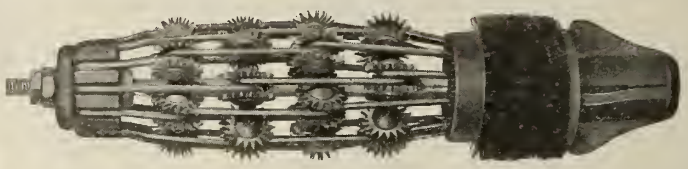
A GOOD INVESTMENT

IS MONEY SPENT IN KEEPING THE BOILERS CLEAN

HERE ARE TWO OF THE BEST MEDIUMS

"EVERLASTING" BLOW-OFF VALVE—THE "FLEXIBLE" TUBE CLEANER





The "FLEXIBLE" Tube Cleaner does a better job with half the labor. It rolls through the tube. Sent on trial if desired.

Engineering Specialties Company

1080 King Street West — TORONTO, ONTARIO

AGENTS:

H. L. PEILER & CO., 380 St. James Street, Montreal

THE A. R. WILLIAMS MACH. CO. OF ST. JOHN, N.B., LTD., St. John, N.B.

P. D. McLAREN, LIMITED, Calgary, Alta.

The Murphy Automatic Smokeless Furnace

In "The Power House" we have listed—from time to time—"Canadian Experiences." We now give you "Experiences" of some of the leading industries in the United States:

28 YEARS' EXPERIENCE.

LOCKPORT PAPER COMPANY, - - - - - - - - - -			Lockport, N.Y.
1st order Nov., 1884	1 furnace	150	H.P.
2nd order Dec., 1887	2 furnaces	300	H.P.
3rd order Nov., 1893	4 furnaces	600	H.P.
4th order Nov., 1896	1 furnace	150	H.P.
5th order Feb., 1903	1 furnace	175	H.P.
6th order Apr., 1911	2 furnaces	275	H.P.
1884-1912, six orders	11 furnaces	1,650	H.P.

To install furnaces covered by 6th order, one furnace which had been in use 27½ years was displaced—the boiler having been condemned by the Insurance Company. The two old furnaces covered by their second order have been in use 24½ years, and are in use to-day—Oct., 1912. They have been used 24 hours per day and 365 days per year—less 12 hours per week and times cut out for cleaning.

27 YEARS' EXPERIENCE.

LOCKPORT LIGHT, HEAT & POWER CO. — Lockport, N.Y.
(Formerly American District Steam Co.)
1885-1904—five orders—8 furnaces—1732 H.P.

22 YEARS' EXPERIENCE.

CINCINNATI STREET RAILWAY COMPANY — (Now Cincinnati Traction Co., Cincinnati, Ohio.
1889-1912—15 orders—62 furnaces—10,920 H.P.

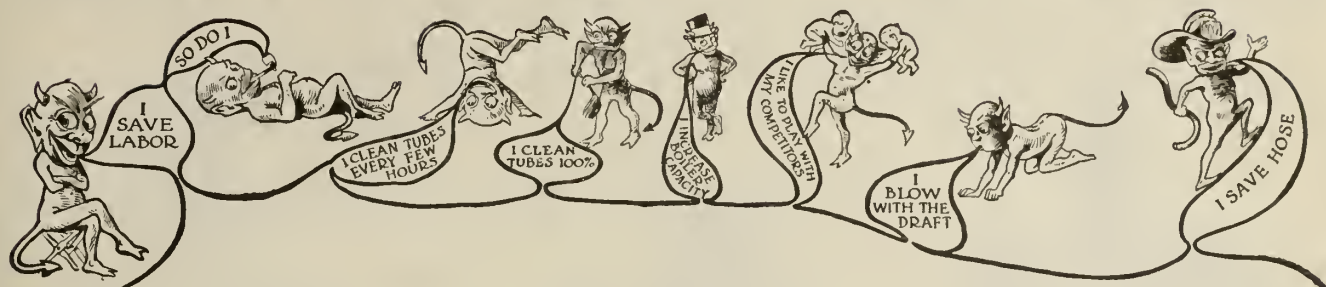
21 YEARS' EXPERIENCE.

CAMBRIA STEEL COMPANY, — Johnstown, Pa.
1890-1907—36 orders—282 furnaces—51,140 H.P.

For printed matter address: *"THERE MUST BE A REASON FOR REPEAT ORDERS."*

MURPHY IRON WORKS, Detroit, Mich.; Buffalo, N.Y.

THE VULCAN IMPS


I SAVE LABOR
SO DO I
I CLEAN TUBES EVERY FEW HOURS
I CLEAN TUBES 100%
I INCREASE BOILER CAPACITY
I LIKE TO PLAY WITH MY COMPETITORS
I BLOW WITH THE DRAFT
I SAVE HOSE

"And We All Save Coal"

Wherever the **VULCAN SOOT CLEANER IMPS** are allowed to work they raise the Devil—the Soot Devil. They juggle the heat units and make two units grow where one unit grew before. They make slow steaming boilers "pop" for the first time in years. They give many a weary engineer and fireman a chance to rest. The IMPS are always on the job, "they work while you sleep." They cut out lost time, trouble and repairs. They are good for the operating man and mighty good for the boiler owner. Don't let Soot, the expense maker, worry you longer. Fill out the coupon, mail it now, and we'll send you our Free Booklet, "Economical Steam Production," which shows how the Vulcan removes Soot, and saves from 5 to 15% in fuel.

Mail the Coupon

Vulcan Tube Cleaning Systems,
LIMITED

42 Craig St. West **MONTREAL**

SIGN, TEAR OUT AND MAIL

P.H. 10-12. Date.....

VULCAN TUBE CLEANING SYSTEMS, LIMITED, Montreal.

Please send me, without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.

(It is important that following information be given in full.)

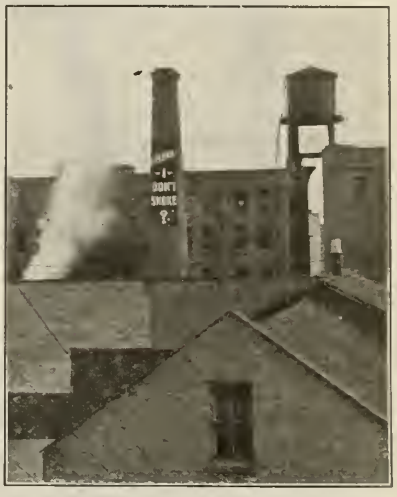
WATER TUBE BOILERS. Number.....Type.....
Pressure .....Horsepower .....No. Tubes H
(except on Stirling boiler .....Any Superheaters .....Width of alley space at side .....
TUBULAR BOILERS. Number.....Horizontal or Vertical .....
Name .....
Address .....

THREE JONES UNDERFEED STOKERS, HELENA COSTUME CO.

EVERYBODY PLEASED!

The chimney has "Quit the habit" and pleased the neighborhood! What the Stokers are doing is pleasing the Owners!

Increased Sales have pleased us!



STACK OF HELENA COSTUME CO., LONDON, ONT.
Photograph taken July 11, 1912, with stokers in operation carrying regular load.

THIS STOKER EQUIPMENT PAID FOR ITS COMPLETE INSTALLATION IN ONE YEAR.

Saved them 25.88 per cent. over previous costs for steam!

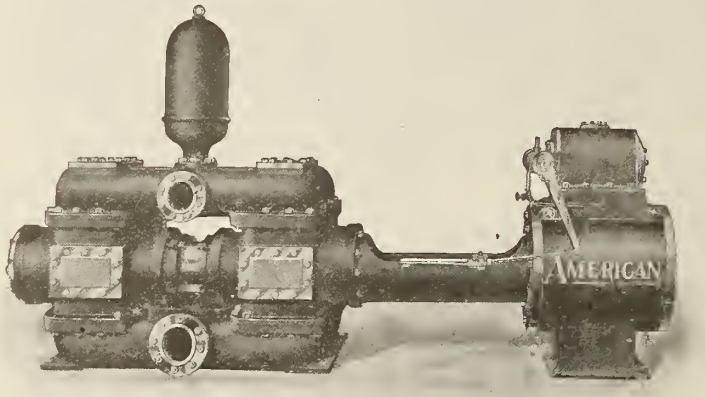
Is now earning and paying **DIVIDENDS!**

JONES UNDERFEED STOKER COMPANY
LIMITED

NATIONAL TRUST BLDG. **TORONTO**

American Steam Pumps

Reputation built on Quality not Cheapness.



CANADIAN AGENTS: A. R. Williams Machinery Co., Toronto; Williams & Wilson, Montreal; London Engine Supplies Co., London; Stuart Machinery Co., Winnipeg; Hallman & Peniston Machinery Co., Vancouver; Gorman, Clancey & Grindley, Ltd., Edmonton and Calgary; Mechanics Supply Co., Quebec.

A WORD AS TO CONSTRUCTION

Phosphor bronze wearing parts throughout, including water bushings, piston rods, stuffing boxes and valve seats. Heavily constructed water ends built amply strong to withstand any unforeseen strain.

NOTICE THE STEAM END

No slide valves to wear. Steam valve of the balanced piston type. The feature in the American Pump that appeals to engineers is that the steam end wears as long as the water end.

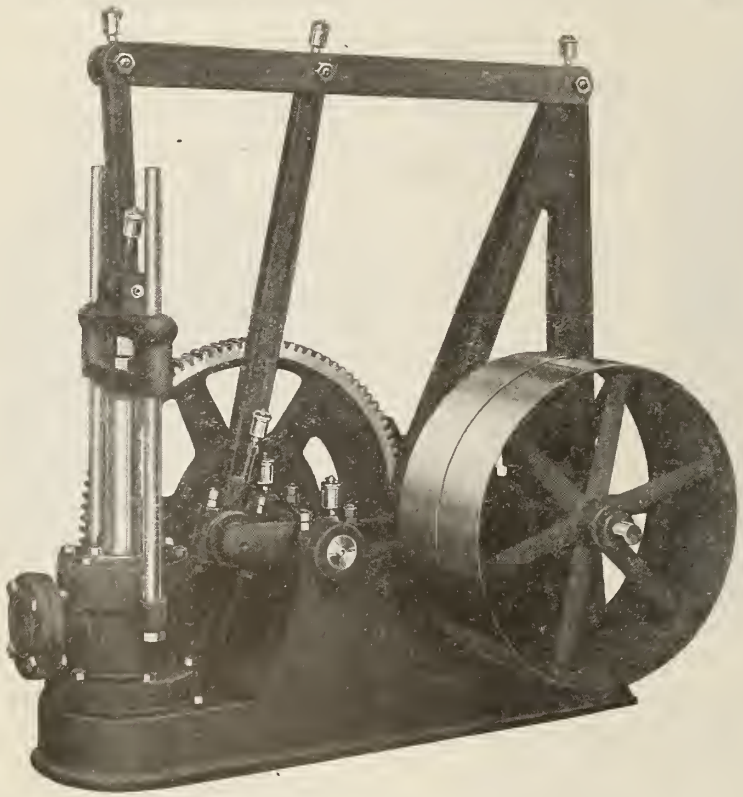
A RECENT INSTALLATION

Twenty-four American Pumps including six compounds were recently installed in the new McAlpin Hotel in New York City, the largest hotel in the world. American Pumps were chosen after careful investigation in competition with numerous other makes.

ASK FOR CATALOG.

AMERICAN STEAM PUMP COMPANY

Battle Creek, Mich.



In our own factory for several years we have been using one of these Fig. 62 working heads, direct connected to motor. We have hundreds of letters from power plants which testify to the economy and excellence of Deming Power Pumps and working heads.

DEMING POWER PUMPS

AND DEEP WELL WORKING HEADS

are made for operation by electric motor, gasoline or steam engine, direct connected; or by belt from any source of power.

They require so little attention that they are almost automatic, and they represent a fuel economy of about 80% over direct acting pumps.

To factory officials who are interested in pumping equipment, we shall be glad to send our Catalogue "H" of power pumps. This book has been "reviewed" as the most complete and beautiful pump catalogue ever printed.

The Deming Company

SALEM, OHIO

HAND AND POWER PUMPS FOR ALL USES

GENERAL AGENCIES:

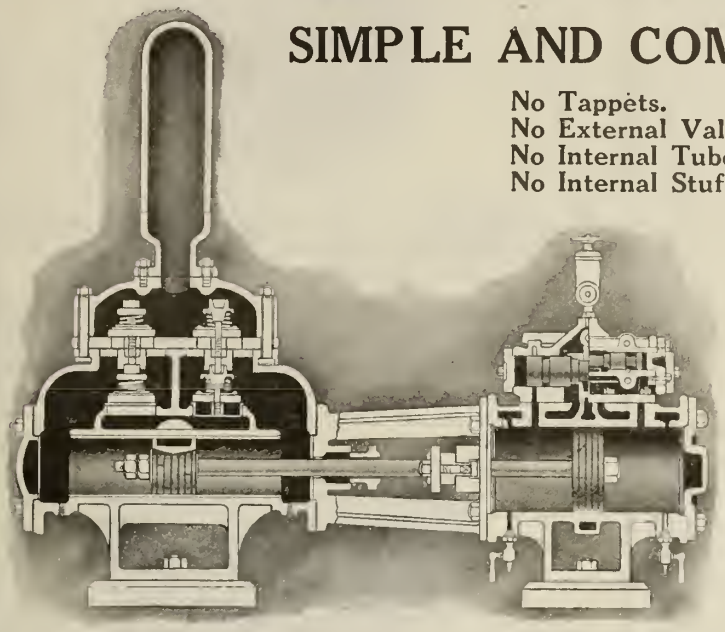
Henion & Hubbell, Chicago.
Darling Bros., Montreal, Can.
Root, Neal & Co., Buffalo, N.Y.
Ralph B. Carter Co., New York.
Other agencies in principal cities.

"BAWDEN" STEAM PUMPS

MANUFACTURED UNDER ATTWOOD'S PATENTS

SIMPLE AND COMPOUND, For all Purposes

No Tappets.
No External Valve Gear, Levers or Springs.
No Internal Tubes.
No Internal Stuffing Glands.



"Bawden" Pumps are governed by piston valves which are controlled by the action of live steam only.
—Simplicity throughout.
—Greatest economy of steam consumption.
—Valves, latest improved steam balanced type.
—Guaranteed to make full stroke under constant or varying loads.
The Bawden Pump provides the simplest, most economical and reliable means for feeding high or low pressure boilers.
Flexibility of speed obtained without any mechanical adjustment.
Automatic cushioning of piston and valves ensures greatest safety in any emergency.

THE BAWDEN MACHINE CO., Ltd., Toronto, Can.

BURNHAM STEAM PUMP

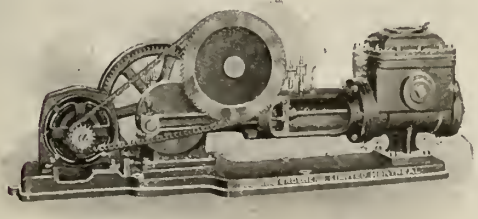
Of the thousands of steam pumps installed every year, a large percentage of them bear the name of "Burnham," the **Steam Pump** endorsed by leading Architects, Consulting Engineers and Heating Contractors as the best, simplest and most economical pump on the market.

If you want a pump for handling hot water, use the "Burnham."

Burnham Boiler Feed Pump.

Thousands of Burnham pumps are in operation in connection with **Vacuum Heating Systems**; they are specially adapted for this service. Standard Burnham Boiler Feed Pumps and Burnham Vacuum Pumps are kept in stock and can be shipped promptly.

Ask for Catalogue "P."

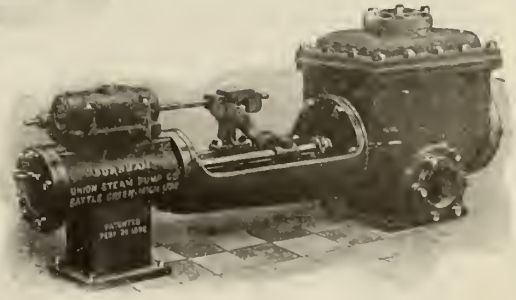


Union Electrically Driven Vacuum Pump.

Darling Brothers,
LIMITED

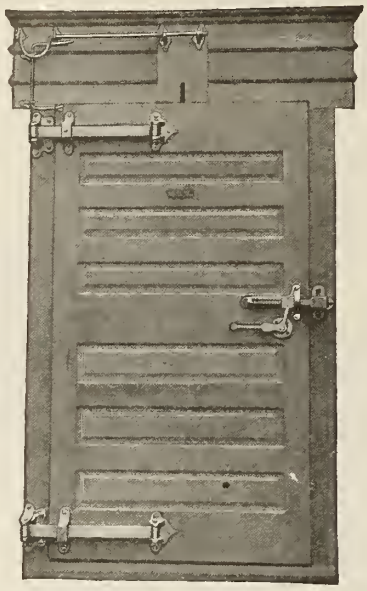
15 Ottawa St., Montreal.

Toronto, Winnipeg and St. John.



Burnham Vacuum Pump.

J. V. Jamison, President. T. B. South, Vice-President. J. V. Jamison, Jr., Treasurer.



This "Ad" is addressed to users of

Refrigerator Doors, Windows and Ice Chutes
in Canada

for Cold Storage, Meat, Fish, Dairy, Poultry, Fruit and Vegetable products.

We guarantee our Doors not to sag or stick in the frames.

Our Hardware weighs 60 lbs. to set.

We manufacture or sell nothing else.

Our entire time and forces are directed to this line.

We supply

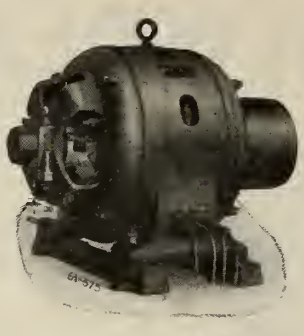
Linde British Refrigeration Co.
Linde Canadian Refrigeration Co. of Canada.
Armour & Co., Chicago, Ill., U.S.
Swift & Co., Chicago, Ill., U.S.

with all they use. Our latest orders are to Swift & Co., for Toronto, Can., 30 Doors; Canadian Fish and Cold Storage Co., Prince Rupert, B.C., 110 Doors.

Send for Catalogue

Jones Cold Store Door Co.

HAGERSTOWN, MARYLAND, U.S.A.



Wagner Motors

The pre-eminent position occupied by the Wagner Company in the Motor Industry is due in part to the liberality of design and robust construction which has ever characterized Wagner Motors. In comparison with other makes, they stand in a superior class.

Wagner Transformers

Are built for service. Every feature has been considered in their design and construction and all conflicting features are so correlated as to insure the HIGHEST Efficiency and ABSOLUTE Dependability.

Other Wagner Specialties include

Generators, Rectifiers, Rotary Converters

Address your inquiries to Dept. 2075.

All for sale by

THE Northern Electric AND MANUFACTURING CO. LIMITED

Manufacturer and Distributor of Telephone Apparatus, Electrical Supplies and Fire Alarm Apparatus for every possible need.

Montreal, Halifax, Toronto, Winnipeg, Regina, Calgary, Edmonton, Vancouver.

Why Consider the First Cost

When by paying higher prices your brush cost is reduced and commutator wear abolished.

The

"LE CARBONE" BRUSH

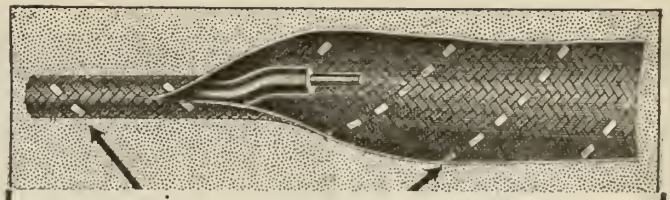
will do this and more for you. Although the highest priced brush on the market, it is known the country over as the most economical.

We have a most instructive catalogue, showing Carbons for Commutators, Slip Rings, and Telephones.

SEND FOR IT.

ROUGIER FRERES, INC.

63 Notre Dame East, - - MONTREAL



Look for this

thread or strand in *green*, woven into the braid of the N. E. C. Rubber Insulated Wire you buy. (A little scraping of the braid will disclose it.) It is a registered

"Sterling" Mark

and your guarantee of *quality*, *economy* and *safety*, based on over thirty years of service. Our booklet "STERLING" is a valuable guide to economical wire buying.

Send for it *now*.

Standard Underground Cable Co. of Canada, Ltd.

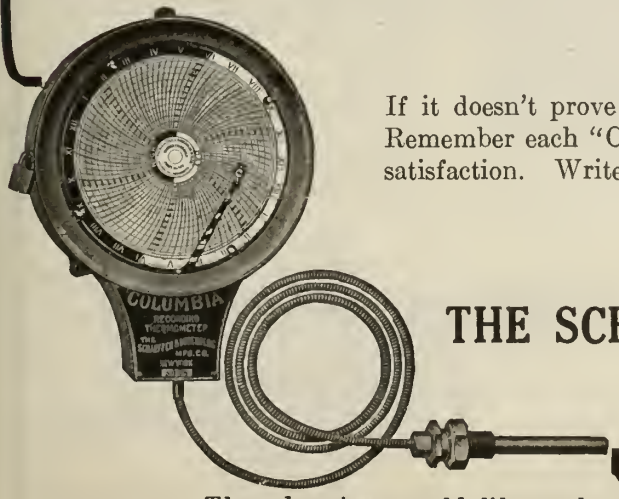
Department B. Hamilton, Ont.

Manufacturers of Electric Wires and Cables of all kinds, all sizes, for all services, also Cable Terminals and Junction Boxes.

The "Columbia" Recording Thermometer

is mercury actuated, let that sink in. For mercury, you know, is the best substance in existence for measuring temperatures. And to combine strength with accuracy the entire mechanism of the "Columbia" is made of steel, meaning long life. Pen arm is adjustable and recording pens are of glass, non-corrosive and non-spilling. Charts are uniformly graduated, have wide effective working range and the night and day border.

On the strength of these and many other exclusive features, we feel justified in claiming the "Columbia" without an equal. But we don't ask you to believe us. Prove it for yourself—send us your order for a "Columbia."



Give It A Trial

If it doesn't prove satisfactory, send it back—there is no expense to you. Remember each "Columbia" leaves our shop fully guaranteed to give absolute satisfaction. Write for full particulars.

Send for Catalogue W-28 now.

THE SCHAEFFER & BUDENBERG MFG. CO.

Brooklyn, N. Y.

Chicago **Pittsburgh**

(91)

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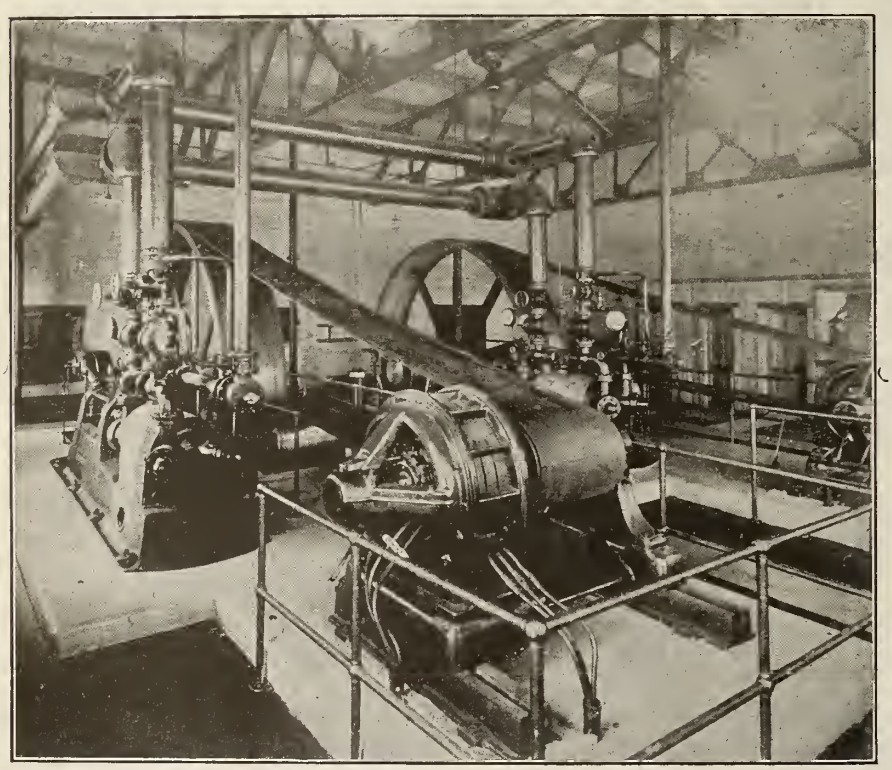
REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt Driven, Double Acting, Horizontal Ammonia Compressors Manufactured and Installed by us in Canada.

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McGILL UNIVERSITY, Montreal, P.Q.

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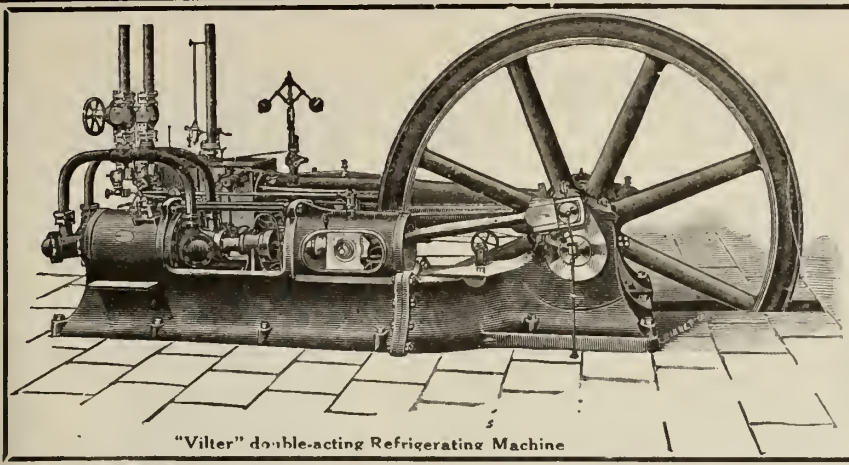
AND MANY OTHERS.

The Linde Canadian Refrigeration Co., Limited

37 ST. PETER STREET, MONTREAL.

BRANCH OFFICES—Toronto, Imperial Building, Adelaide St.; Winnipeg, 909½ Main Street; Vancouver, Anderson & Miskin, Imperial Block, Seymour and Pender Streets; Edmonton, Walker & Barnes, 562 Second Street; Calgary, General Supplies Limited, 1233 2nd Street East.



"Vilter" double-acting Refrigerating Machine

Established 1867

The VILTER MFG. CO.

242 Becher St. Milwaukee, Wis.

BUILDERS OF HIGH-GRADE

CORLISS ENGINES
ICE AND REFRIGERATING MACHINERY

any size and for any purpose, complete line Ammonia Fittings, Condensers, Brine Coolers, etc.

Write for Catalogue and full Particulars

The
LINDE BRITISH
Refrigeration Co. Limited

¶ Numerous fully authenticated laboratory tests organized from time to time in America and Europe, have invariably served to demonstrate in an unanswerable manner, the very remarkable degree of mechanical efficiency to which our products have been brought. *The history of mechanical refrigeration is our history.*

Head Office: LONDON, ENG.

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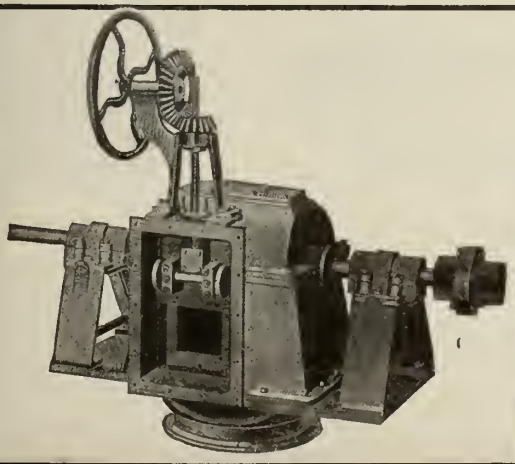


Little Giant Water Turbine

Self-contained Unit

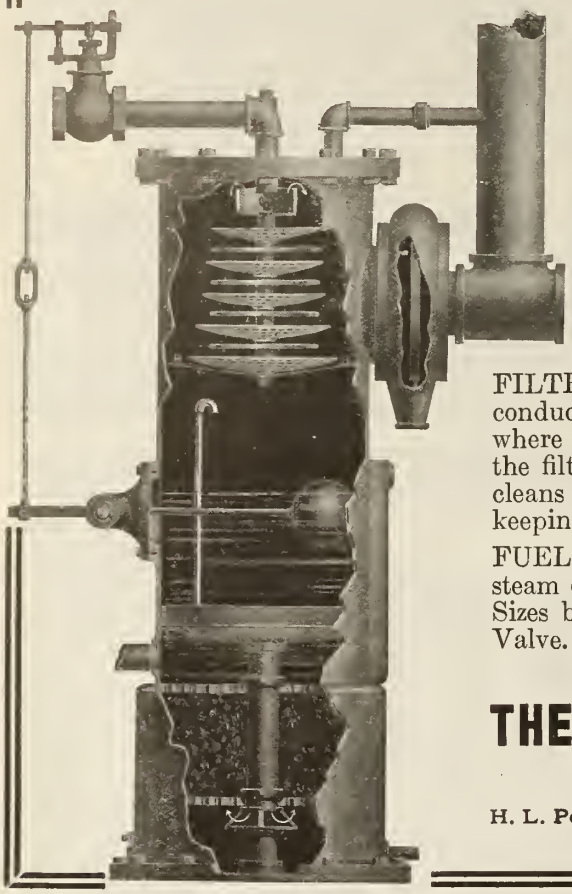
Mounted on vertical or horizontal shafts. Gate consists of single casting, and is trouble proof. Adapted for all heads. Highest efficiency guaranteed.

Write for Catalog. Prices will Interest You.

J. C. WILSON & CO.

Founders and Machinists. GLENORA, ONT.

The "SIMS"



Open Feed Water Heater, Filter and Purifier

is made of CAST IRON throughout—the only material not subject to pitting or corrosion. The shell is round, therefore stronger than any square construction, and is cast in one piece—no rust joints to cause trouble.

An even water level is maintained by an automatic inlet valve, controlled by a ball float, and perfect distribution of water in the steam chamber is obtained by passing it over a series of trays or saucers, giving the effect of a shower.

FILTERING UPWARD through a bed of COKE is obtained by conducting the water to the bottom or Mud Chamber of the heater, where the heavier impurities settle by gravity, thence upward through the filter, to the pump suction. Opening the Blow-off valve not only cleans out the mud chamber, but thoroughly flushes the Filter bed, keeping it in a high state of efficiency.

FUEL SAVED: about 15%; Water saved to the extent of the exhaust steam condensed in heating the feed water.
Sizes built—50 H.P. to 2500 H.P., with or without By-Pass Cut Out Valve.

THE SIMS COMPANY, Erie, Pa.

CANADIAN REPRESENTATIVES:
H. L. Peiler & Co,, 380 St. James Street, Montreal, Que., and 69 Adelaide Street West, Toronto, Ont.

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MANUFACTURERS OF HEAVY CHEMICALS

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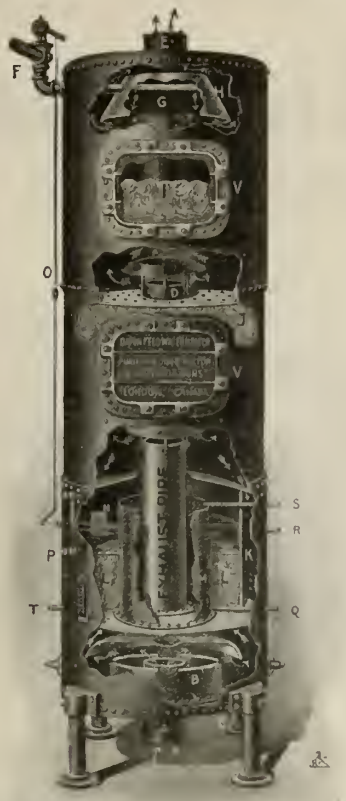
TRI-SODIUM PHOSPHATE
T. S. P.
FOR STEAM BOILERS

Sole Selling Agents

CANADIAN SALT COMPANY'S

"WINDSOR BRAND" Caustic Soda and Bleaching Powder.

The only Canadian makers of Caustic Soda and Bleaching Powder.



"DAKIN"

Feed Water Heater, Purifier and Oil Extractor

This Heater is of the "open" type, in which the entering water is heated to about boiling point by coming in contact with the exhaust steam before entering the boiler. The water passes through three filtering chambers, which frees it from all impurities, with the result that the boiler is kept cleaner and its economy increased greatly.

MADE BY

E. LEONARD & SONS, LONDON, ONT.

MANUFACTURERS OF

High and Slow Speed Engines of all types for all purposes. Boilers of all kinds built to pass all Provincial Inspection Laws.

WAREHOUSES AND AGENCIES AT

MONTREAL. ST. JOHN. N.B., CALGARY, WINNIPEG, VANCOUVER

ROBB VERTICAL TAPER COURSE BOILER

¶ *Space Saver*—
It's the small floor space—the smallest floor space—per horse-power that gives the vertical boiler the advantage for limited areas.

¶ *Coal Saver*—
It's the economy and the continued economy that has caused the vertical boiler to be so widely used. It's internally-fired—saves radiation losses. Its passages for the hot gases are direct—insures good draft.
It has large combustion chamber surrounded by heating surface—perfect combustion.

¶ *Trouble Saver*—
It's the ease of inspection and cleaning that cuts down the cost of maintenance. Carrying up the shell the full diameter to a point about six feet above the crown sheet allows a man to walk around the edge. Handholes placed opposite the wide cleaning spaces make it easy to wash off the crown sheet without removing the manhole plate.

Ask for Bulletin No. 2.

INTERNATIONAL ENGINEERING WORKS, LIMITED

Owners of the Works formerly of

ROBB ENGINEERING COMPANY,

AMHERST, N.S., CANADA. **SOUTH FRAMINGHAM, MASS.**

SOLE CANADIAN AGENTS FOR
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Turbines, Turbo-Electric Generators, Turbo Pumps, Blowers and Compressors.

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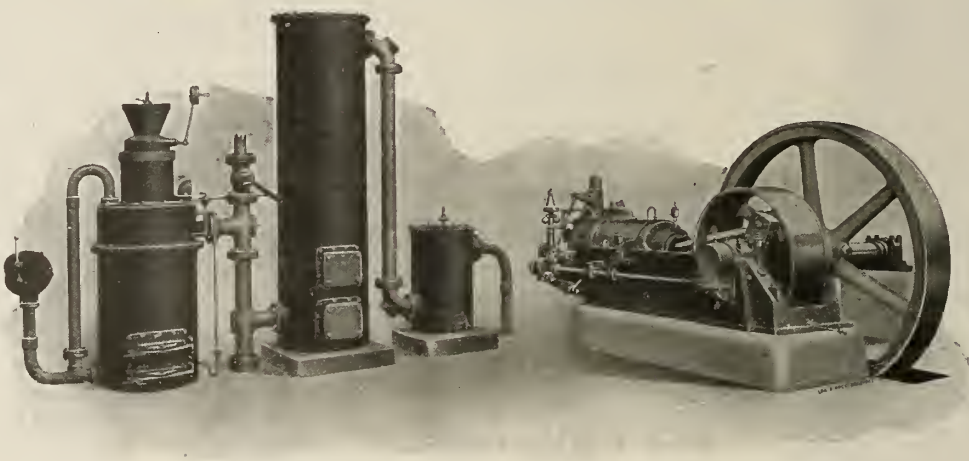
Sole Makers of the **"Robson"** Oil Engine for working on Crude and Petroleum Oils.



Sole Makers of the **"Robson"** Engine for working on Towns and Suction Gas.

Photograph of Gas Engine and Suction Gas Producer Plant.

Suction Gas Producer Plants for working on Anthracite Coal, Coke or Charcoal.

AGENTS WANTED. **WRITE FOR CATALOGUE.**

WATER TURBINES

—AND—

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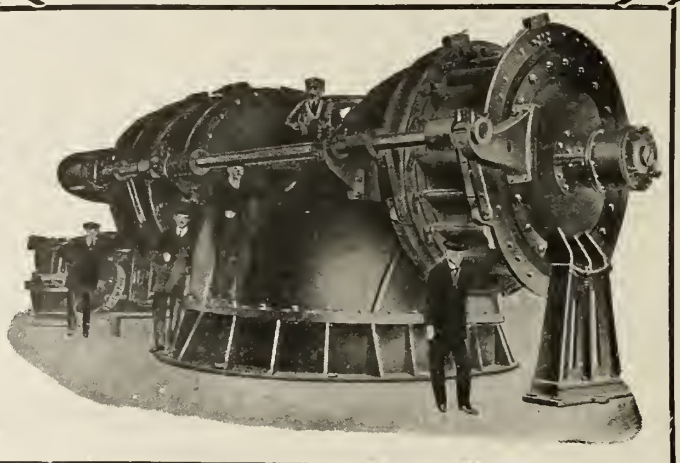
Maximum Efficiency



All Heads

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THE CANADIAN BOVING CO., LTD.

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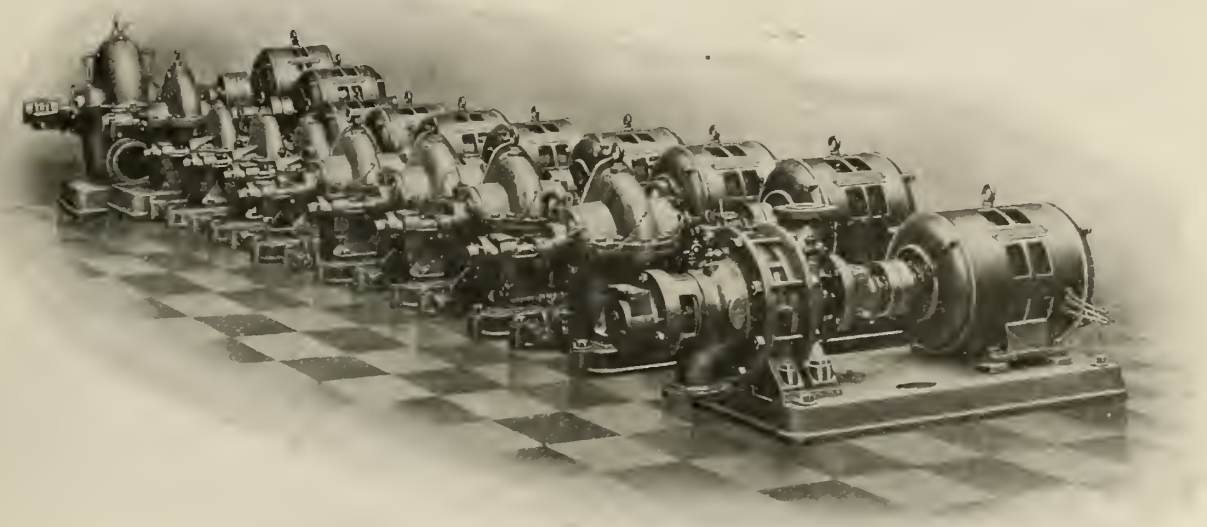
The advertiser would like to know where you saw his advertisement—tell him.

Ten Pumps Used As Main Water Pumps

Supplied to the DRYDEN TIMBER & POWER CO.



The illustration represents Ten Pumps used as Main Water Pump, Caustic Liquor Pumps, Special Digester Pumps, Boiler Feed Pump, and was supplied to the Dryden Timber and Power Co., of Dryden, Ont.

The majority of these pumps are of special types and specially designed for this class of work, and the whole manufactured by Messrs. W. H. Allen Son & Co., Bedford, England. These are coupled direct to special ball-bearing motors of the star delta and mesh types, manufactured by the Lancashire Dynamo and Motor Co., of Manchester, England.

The horse power of these motors running from 10 to 150 h.p.

The whole erected and connected by Chapman & Walker, Ltd.

W. H. ALLEN, SON & COMPANY
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QUEEN'S ENGINEERING WORKS. **BEDFORD, England**

Canadian Representatives:

CHAPMAN & WALKER, LTD.

69 Victoria Street, TORONTO

Resident Engineer for Canada: A. LEO MIEVILLE, A.M. Can. Soc. C. E.

HOW can any engineer permit the escape of exhaust steam?

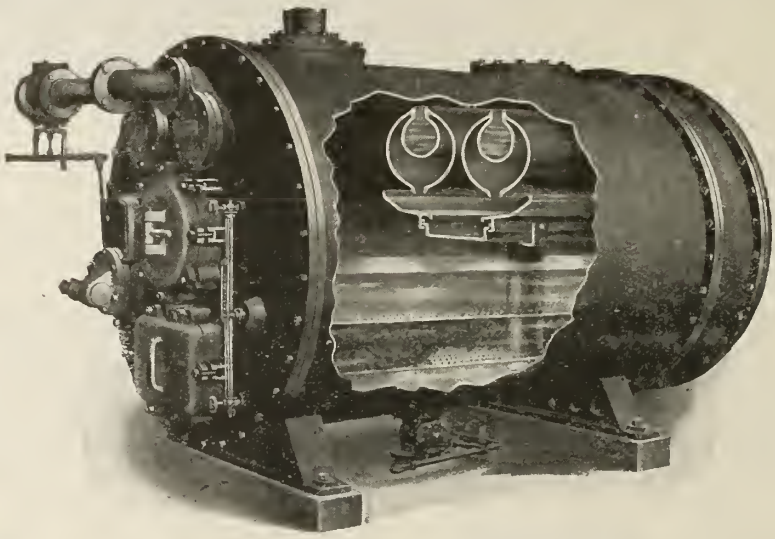
Surely he can figure the available heat in it.

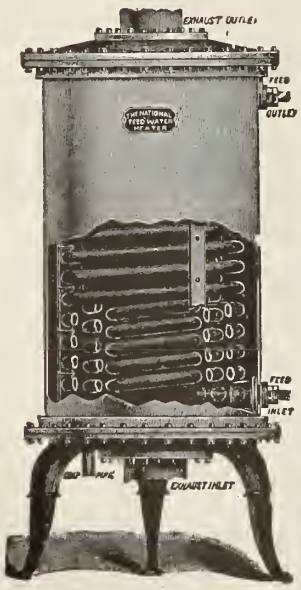
Then why not use it?

The engineer who suggests a

NATIONAL
FEED WATER HEATER

stands in with the management, because it's so easy to show economy.





NATIONAL "DIRECT CONTACT" HEATER

New design of open heater—combines feed water heater, oil separator, purifier, filter and hot well. Ask for catalog.

If it's a closed heater you want—

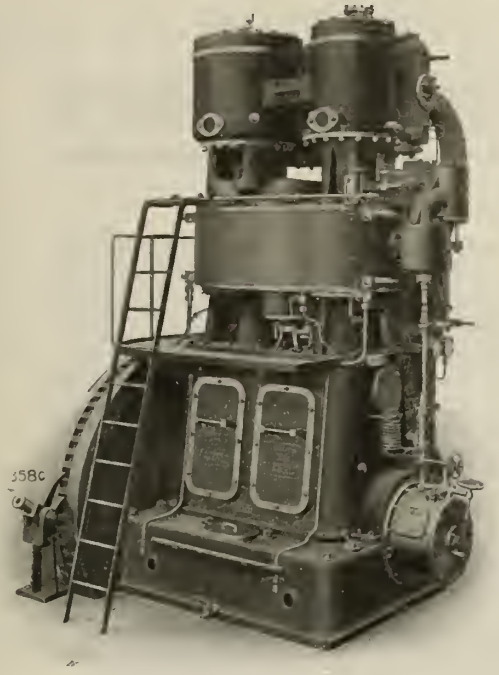
The **National** is the one to buy for its coils never show the leaks of straight tubes. The feed water never comes in contact with the shell—nor with the exhaust steam containing oil. Feed water, clean and hot, (210° to 212°), saves coal and adds to the life of the boiler. Ask for catalog.

The National Pipe Bending Company

91 Lloyd Street, NEW HAVEN, CONN., U.S.A.

46-10

AIR COMPRESSORS

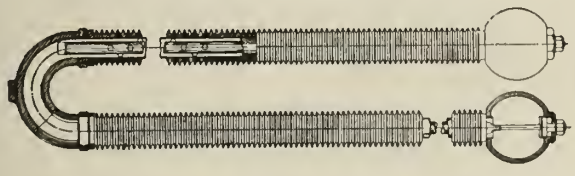


Belliss Compressors
are coming into favor in Canada, because of their

Low Initial Cost
High Efficiency
Reliability
Low Cost of Up-keep
Low Oil Consumption

MANUFACTURED BY
BELLISS & MORCOM, LTD.
BIRMINGHAM, ENG.

AGENTS:
LAURIE & LAMB
ENGINEERS
BOARD OF TRADE BLDG., - MONTREAL

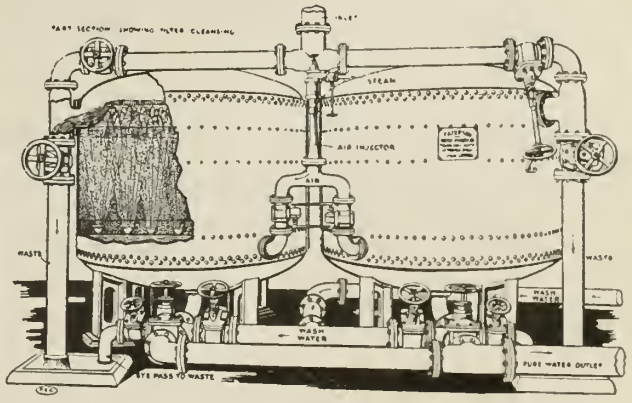


FOSTER SUPERHEATER

Saves
19%
of your coal bill

AGENTS
Laurie & Lamb
BD. OF TRADE BLDG. MONTREAL

WATER PURIFIERS



Write to
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FOR
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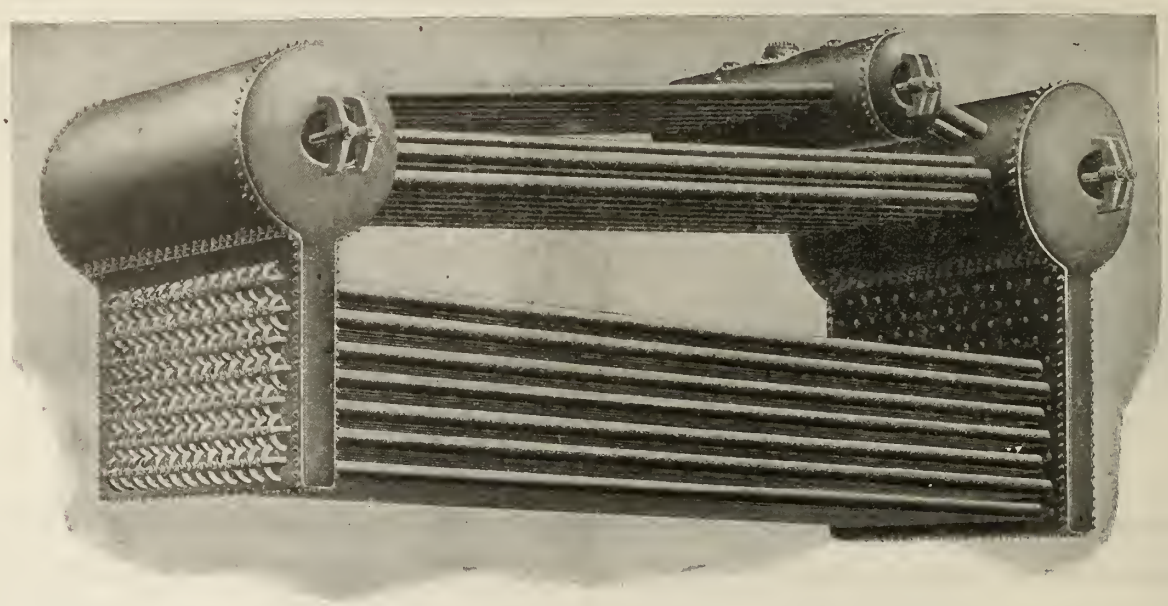
ON
WATER SOFTENING and PURIFYING

The advertiser would like to know where you saw his advertisement—tell him.

Canada Water Tube Boilers



ARE UNSURPASSED IN

Safety, Durability, Economy, Accessibility, Efficiency, Combustion, Superheated Steam Capacity, Unimpeded Circulation, Universal Flexibility, Simplicity, Feed Water Purification, Cleaning Facilities.

Boiler Feed Pumps, Return Tubular Boilers, Feed Water Heaters.

Canada Foundry Co., Limited

Toronto Montreal Halifax Cobalt Porcupine, Winnipeg
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The advertiser would like to know where you saw his advertisement—tell him.

SAVE $500

BY BUYING ALL COMBINED

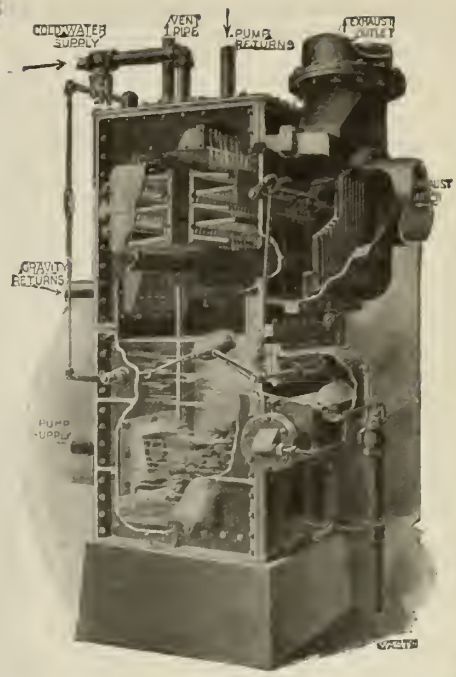


Fig. 1.—The Cochrane Steam-Stack and Cut-Out Valve Heater and Receiver Replaces the Entire Closed or Pressure Heater arrangement.

A Cochrane Steam-Stack and Cut-Out Valve Heater and Receiver combines the functions of the following pieces of apparatus:

A first-class open feed water heater;

A separator large enough to purify all the exhaust steam delivered by the engine, including that utilized in the exhaust steam heating or drying system or low pressure turbine;

A return tank or hot well, for the reception of condensate, drips from live steam traps, and any other water suitable for boiler feeding;

An automatic make-up water regulator, for supplementing the condensed returns with just the amount of cold water needed to make up the total boiler feed supply; and

Suitable valves for cutting the heater out of communication with the separator and trap when it is desired to open the heater for any purpose, while the separator and trap remain in service purifying the exhaust steam passing to the heating system.

Where the water requires softening, the functions of the heater can be extended as in the **Sorge-Cochrane Hot Process Softening System,** to include the feeding of a suitable reagent for the precipitation of permanent hardness, so that hard scale will not be formed in boilers, which will also be protected against corrosion.

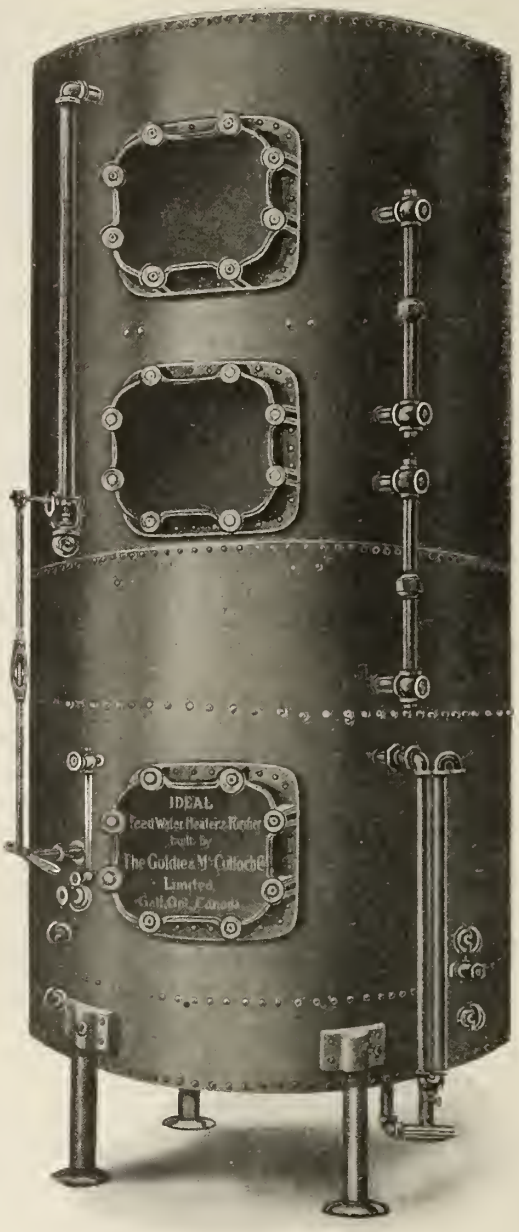
For the latest engineering information regarding the Profitable Utilization of Exhaust Steam in Condensing and Non-condensing Steam Power Plants, send for our new 140-page Cochrane Heater Catalogue.

Canada Foundry Company, Limited

TORONTO MONTREAL HALIFAX OTTAWA COBALT
PORCUPINE WINNIPEG CALGARY VANCOUVER
NELSON PRINCE RUPERT

The "IDEAL" Feed Water Heater, Purifier and Oil Extractor Pays for itself quickly.

This Heater effectively extracts all oil and grease from the exhaust steam, and removes all carbonate scale-forming matter from the feed water.



It will deliver the feed water to boiler at nearly boiling temperature. The construction of Heater is such that all parts are easily accessible.

ASK FOR CATALOG AND FURTHER PARTICULARS.

The Goldie & McCulloch Co., Limited

GALT, ONTARIO CANADA

WESTERN BRANCH
248 McDermott Ave., Winnipeg. Man.

MARITIME PROVINCES
13-15 Dock Street, St. John, N.B.

QUEBEC AGENTS
Ross & Greig, 412 St. James Street, Montreal, Que.

BRITISH COLUMBIA AGENTS
Robt. Hamilton & Co., Vancouver, B.C.

Where Belliss & Morcom Engines and Turbines are Built

One of the best known enclosed vertical high speed engines on the market is that built at Birmingham, England, by Messrs. Belliss & Morcom, Ltd. Many installations of these engines are to be found in all parts of Canada, where they have given uniform satisfaction.

THE works of Messrs. Belliss and Morcom at Birmingham, Eng., were founded half a century ago by the late Mr. George E. Belliss, and in 1884 he was joined by Mr. Alfred Morcom, who then gave up a position in the navy to enter commercial life. The naval experience of Mr. Morcom had the effect of directing the energies of the firm into the sphere of marine engineering, and they supplied a great deal of machinery for the smaller war-vessels; many torpedo-boats, gunboats and destroyers having been fitted with engines built in the old works of the firm. Minimum weight per horse-power has always been of great importance in war-vessels, and this led to the evolution of the quick-running type of engine. Though auxiliary machinery for warship and central station use is still an important branch of the firm's work, the building of marine engines for propelling purposes and of boilers has been given up for many years, as the enormous development of the special engines and condensing plants for electric power, lighting, traction, mill work, etc., fully occupy the resources of the company. The Belliss engine has reached its present position as much through the result of extended experience as of careful manufacture and supervision.

Steam Turbines.

In recent years the firm have added to their products the manufacture of steam turbines and kerosene engines. Although experimental work on the turbine problem was begun some eight or nine years ago, they deliberately avoided placing a turbine on the market until they had satisfied themselves that they could offer a reliable machine. Several experimental machines were built, one of which, of the exhaust steam pipe, coupled to the exhaust mains of the shop engines, has been working daily on a 28½-in. vacuum since the end of 1907. Although it is only 200 kw. capacity, the saving in the power house costs amounts to 1,000 long tons of coal a year.

The Belliss and Morcom turbine is entirely of the impulse type, but is usually drum built—that is to say, the moving blades are attached to a drum instead of to a series of discs, and, according to pressure conditions, etc., this drum-built section may be combined with stages which are compounded for velocity. The advantage of the impulse type of turbine lies in the comparatively large clearances permissible; and in the drum-built design, low speeds of revolution with the proper number of stages can be combined to give the best economy.

Careful consideration of the problem led to the conclusion that below 1,500 kw. so many advantages are possessed by reciprocating engines that the adoption of a turbine is, only in exceptional cases, good practice. In the case of exhaust steam turbines, however, the limiting size is much lower, and the firm now build them in sizes down to about 200 kw.

The older works at Ledsam Street, which have been completely reorganized and brought up to date, are employed in the manufacture of auxiliary machinery and small engines for ship and house lighting. The larger engines and turbines, for use in factories and electricity stations, which form the greater part of the firm's output, are constructed at the newer works in Icknield-square. The shops here are capacious, well-lighted, and arranged for orderly production. The floors are laid with wood blocks and a comfortable temperature is maintained by a carefully-regulated system of ventilation and steam heating. The whole factory is electrically driven, and in addition, electrically driven compressors provide compressed air service to all parts.

Power House Plant.

Current for power and lighting purposes is generated in a central station under most economical conditions. Local canal-carried coal is taken direct from the barges to the front of the boilers by an electrically-driven conveyor. The power house, with its four large modern boilers, mechanical stokers, and economizers, is designed for high efficiency, and a Lea recording water meter, showing at a glance the water consumption per hour, an instrument for recording the percentage of CO_2 in the waste gases, and charts automatically recording the temperature and pressure throughout the day ensure economical working.

Steam is delivered to the engines at 160 lb. pressure after being superheated in flue-fired superheaters to about 500 deg. The engines are of the company's standard triple-expansion type, and exhaust into surface condensers in which a 26 in. vacuum is maintained. Two D.C. generators are coupled directly to the engines, having a total capacity of 700 kw. at 220 volts. Circulating water is taken from the canal after being chemically treated by Archbutt and Deeley water-softening plants. The power house has been extended and adapted for testing turbines up to the maximum capacity of the boilers. A large condensing plant has been installed in the basement capable of dealing with a similar quantity of steam, while outside the building an annexe has been built in which are placed electrical resistance tanks capable of taking three-phase or direct current load from the generators tested with the turbines. Two

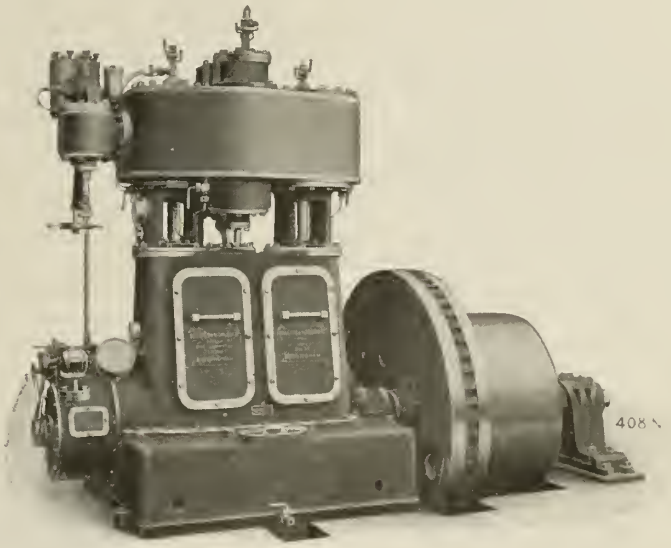


FIG. 1. BELLISS & MORCOM "V" TYPE ENGINE.

special water brakes are also in use, the larger one being capable of absorbing 3,000 h.p. In addition, means are provided for testing exhaust steam turbines, the exhaust steam being taken from the power house engines or from live steam reduced.

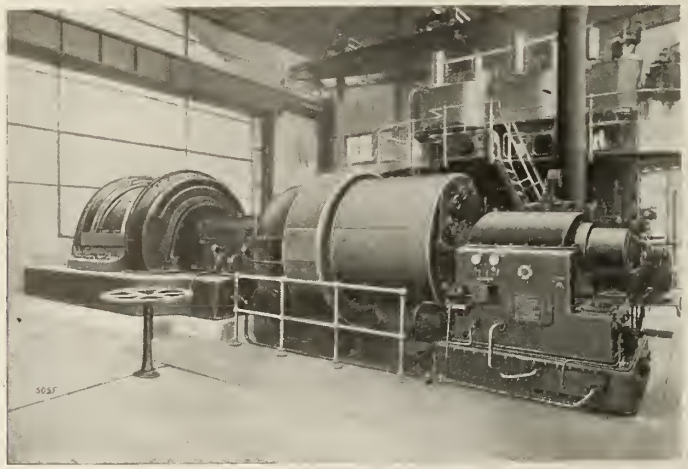


FIG. 3. BELLISS & MORCOM 3,000 K.W. HIGH PRESSURE STEAM TURBINE.

A portable turbine of elementary construction is used for balancing turbine rotors at full speed in the open. All turbine rotors are balanced both statically and dynamically up to full speed before being inserted in their casings.

Shop Equipment.

Alongside the power station is a large pattern shop and stores, where all the patterns for the standard engines are systematically arranged. Their number is estimated at about 25,000. Adjoining the pattern shop is the foundry, with floor space sufficient for 100 tons per week from three cupolas, and cranes and ladles suitable for castings up to 25 tons. Chemical analysis is made of all iron and coke used, as well as a complete series of physical tests of samples taken from the castings and pig iron. Special care is taken in the selection and testing of both the steel forgings and iron castings used. Tensile, elongation, and impact tests are made of the steel, and the hardness, bending and shrinkage are determined with every cast. The microscope is also largely used.

The main machine shop is divided into three bays of 25 ft., 50 ft., and 25 ft. by 280 ft. long. It is served by four traveling cranes electrically driven, and the whole space is covered by jib cranes to facilitate the adjustment of the jigs on the machines. Power for the smaller tools is obtained from line shafting, which in turn is driven by motors, each dealing with a separate group of machines; the larger tools are driven by independent motors.

The tool room situated at one end of the machine shop is equipped with a very complete range of jigs and gauges of every description, and the greatest care is exercised in issuing them to the various departments, each gauge being checked before delivery, on a Whitworth measuring machine recording up to 8 ft. Micrometer calipers, ranging up to 15 in., are extensively used in the works. Over the two side bays are galleries, one of which is used as a small tool shop, and the other for cylinder fitting.

From the machine shop, the work passes into the erecting shop, which consists of two bays each of 50 ft. by 30 ft. It is served by six large traveling cranes, and engines up to 1,250 h.p. can be lifted and carried about the shop complete.

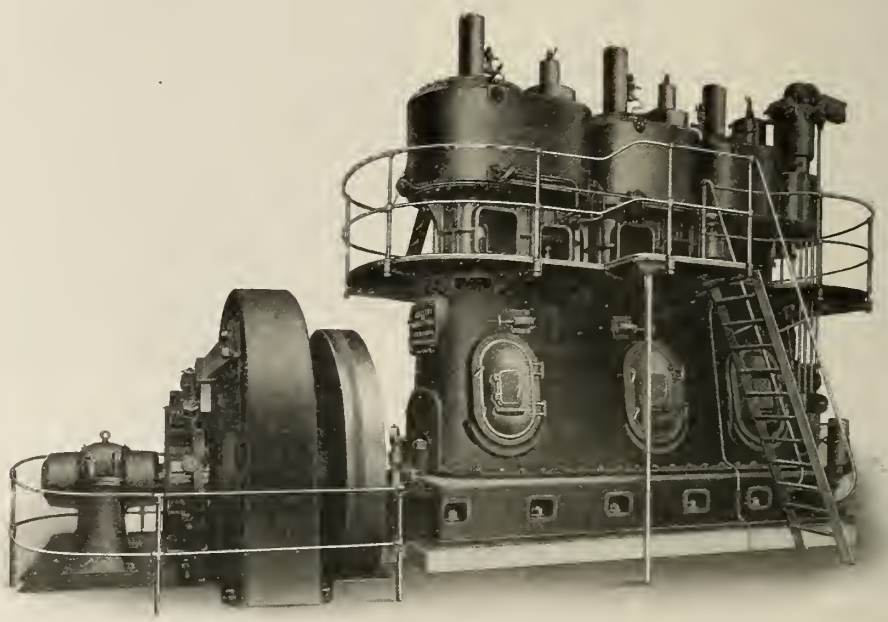


FIG. 2. BELLISS & MORCOM "T" TYPE ENGINE.

The Testing of Engines.

Adjoining the erecting shop is the test house, where the engines are tested after erection. Official trials on brake or dynamo are taken, the trials varying according to specification from 6 to 24 hours. The units tested range in size from 75 h.p. to 1,500 h.p., running condensing or non-condensing, with steam pressures from 80 lb. to 250 lb., and degrees of superheat up to 350 deg. above saturation point. Generators with any voltage, from 60 to 10,000, either direct current, or single or polyphase alternating current, can be dealt with. The sets have to run at full load, light load, and varying loads. Regulation tests of the dynamo and governing tests of the engine are also generally made, and special apparatus is provided for insulation tests and for running on an inductive load.

Steam is raised by five water-tube boilers, capable of producing 25,000 lb. of steam per hour. It is carried either direct to the engine or through a separately fitted superheater. Steam driers are included on three of the boilers. The steam pipe range is designed to supply 12 berths, and is divided into two sections, each of which can be isolated with one or more boilers; in each case tests at different pressures are run simultaneously. The air-pump discharge is passed into tanks attached to Avery balances, on which the amount of water delivered in any given interval is weighed. A series of brakes is kept to suit different sizes, the Heenan and Froude pattern being the one adopted. For trials of combined sets the load is taken up with water resistance tanks, and measured by means of an extensive range of carefully calibrated instruments. After test every engine is thoroughly overhauled to correct any small defects which may have crept through the previous inspections.

Typical Belliss & Morcom Products.

Referring to our illustrations, Fig. 1 shows one of the firm's standard "V" type engines arranged with pulley for a belt drive. These are built in sizes ranging from 90 B.H.P. up to 570 B.H.P. The last named size was specially designed for Canadian requirements.

Fig. 2 represents an engine which is built in larger sizes. This is the "T" type and is largely used for driving electric generators and for general power purposes. It is made in sizes from 260 B.H.P. to 2500 B.H.P.

Fig. 3 is a view in a power plant in Johannesburg, South Africa, and shows a Belliss and Morcom 3,000 k.w. high pressure steam turbine supplied to that city. In the background may be seen one of the "T" type engines. This installation was put in to take the place of a gas plant which had never given satisfaction and ultimately went out of business in a hurry. Messrs. Belliss and Morcom were called in to pull Johannesburg out of the hole in which the city found itself and received an order for two 500 K.W. sets. One engine was already in stock in the Colony; but the other had to be sent out from England. Nevertheless, both engines were erected and running 18 or more hours per day, within six weeks of placing the order—a highly creditable performance.

Canadian Installations.

Among others the following municipalities have installed Belliss & Morcom turbines and engines;—In the Province of Quebec, Montreal, Verdun, Westmount and Farnham; in Ontario, Brockville and Renfrew; in Alberta, Edmonton, Calgary, Lethbridge and Wetaskiwin; and in Saskatchewan, Regina and North Battleford.

The engines are also to be found at the Montreal Technical School; Quebec Technical School; McGill University, Montreal; Toronto University; Queen's College and Royal Military College, Kingston; and at the University of Saskatchewan.

In addition to the above Belliss and Morcom have air compressors or engines, or both, installed in large industrial works in Sydney, N.S.; Quebec, Montreal, St. Johns. Phillipsburg and Sherbrooke, Que.; Kingston, Chatham, Toronto, Windsor and Smith's Falls, Ont.; Transcona, Man.; and other cities.

Messrs. Laurie and Lamb, Board of Trade Building, Montreal, are sole Canadian agents for Belliss & Morcom, Ltd.

—⚙—

Ottawa.—A contract has been awarded to the Windsor Dredging Company for dredging work at Port Stanley, to cost $17,000.

TRAINING THE YOUNG ENGINEER.

MR. CHARLES DAY, Wh.S., M.I.M. E., President, in the course of his inaugural address before the Manchester Association of Engineers, said:—"If a youth can see that his employers are giving him every reasonable opportunity to prepare for the higher positions, he is much less likely to develop into the type of young man who thinks that employers are his natural enemy. It is possible so to arrange the conditions of employment for apprentices that all may have a reasonable chance of fitting themselves for advancement. To put this into practical form, I venture to outline a set of conditions under which apprentices might be employed: (1) All apprentices to start on level terms, i.e., no special privileges either in the number of departments he is allowed to work in or in his treatment. (2) A certain proportion to be given a change of department who have shown mental capacity and satisfactory work in the shops.

Nature of Education Desirable.

The advanced theoretical training of engineers is a subject full of difficulties, for though a high theoretical training is necessary for some positions, the number of such positions is comparatively small. What kind of education is, then, desirable? In the case of many workmen we merely want manual skill with steadiness and attention to work. In the case of an erector, sent out to erect and set to work machinery, a sufficient education is required to enable him to write a clear report, and in addition some knowledge of the principles connected with the machinery. As an instance, I might quote the case of an erector who, on starting up a condensing plants connected with a steam turbine, finds that though he expected to get 28½ inches vacuum, he only gets 27 inches, and then spends time hunting for defective valves and pistons, or air leakages, whereas, had he known the elementary laws in saturated steam he would have at once recognized that the defect in vacuum was due to insufficient water causing the hotwell temperature to be so high as to render a 28½ inches vacuum quite impossible.

For many workmen the capacity to read drawings is essential. For foremen the required qualities vary. For some they are such as mentioned for an erector, but in all cases, a foreman should be familiar with the smallest details of his department, and have considerable knowledge of human nature to handle those under him without unnecessary friction. A foreman in a machine shop does not require to be a mathematician or have a deep knowledge of, say, the theory of heat, but he should know the elements of mechanics and a good deal about machine tools.

There is scope for a scheme to enable foremen and others to see new machine tools at work and get data as to the time expended in doing work with which they are familiar. In the case of draughtsmen technical education needs to be carried further, and in any works a few should have advanced theoretical attainments, so that special problems can be investigated and worked out. The educational qualifications for managers and employers depend on the class of work, but a sound training in first principles and their application is a necessity. It is desirable to know what is going on in other branches of engineering, as it frequently happens that a troublesome new problem in one business has been dealt with and overcome years ago in another. A fairly wide outlook in engineering is of advantage.

The Technical Education Feature.

It is far from my intention to depreciate technical education, but there is a substantial difference between a broad technical education and high theoretical attainments. Though scholastic training can help, and help greatly, it will never be so important as natural qualities. A generation ago an apprentice in an engineering shop probably saw a great variety of work. To-day he probably sees only one branch, or even a sub-branch. For instance, he may work in a shop where lathes only are built, and may only see one small section of this branch. He may work where only small petrol engines are made, and only see that section of the internal combustion engine. Such intense specialization narrows the outlook. A young man may widen his training by changing from shop to shop, but in this he loses opportunities of advancement in the line he started on. This narrowness can be overcome to a considerable degree by suitable training in a technical school equipped with a good mechanical laboratory, as the student then sees and works upon a wide variety of modern machinery. The extensive and varied machinery in the engineering laboratories has much value. There is much to be learned in the laboratories in testing materials—many lessons which can hardly be learned otherwise. Much education called theoretical is really intensely practical, being the reduction to words of accumulated practical experience. Numerous instances could be quoted of engineering problems solved and understood only after years of practical effort, and thus much that is taught in the schools is the boiling-down to compact form of lessons learned by experience. Were it not for this, each generation would to a large extent have to learn by slow experience the lessons of previous generations. Fortunately, this is avoided by the teaching

in engineering schools, by books, by technical literature, and by the papers and discussions before engineering associations such as ours.

Preparation for New Developments.

While considering the matter of training of engineers, it must be borne in mind that new inventions and developments have to be faced, involving quite new lines of thought in their application, and men whose training has been in a narrow groove will probably be unprepared—I do not say unfit, to cope with new problems, or even to appreciate them. A good general technical training forms a better basis for dealing with new problems than a highly specialized one, and makes men more disposed to watch new inventions and developments closely. One point I would add, attention to evening classes should not stop at the age of 21. Attend laboratories and special lectures, and remember that the laboratories as well as advanced lecture courses are available to evening students. Membership of an engineers' association is the next step for young engineers, because the work is of an educational character, and not only gives opportunities for comparing experiences, but, in the variety of papers read, widens the vista of its members. Many young men owe their first step upward to the fact that in discussions before such societies they have been given a clear insight into some engineering problem.

Problems of Position.

Employers and managers have often to consider applications for employment from young men who have taken a course of training at a technical school or college, and who may have done and desire to get practical work. It is by no means easy to deal with this problem, as advanced theoretical training, though of great value in the higher positions, is not of much value in the lower. In fact, there is some danger that the college life and training has the effect of spoiling a young man for the comparatively dull and arduous work of an engineering shop, where each person is judged from a purely productive or money-earning point of view rather than from what it may be possible some years later to make of him. In a few shops young men from the college can be at once used to advantage in testing or experimenting, but in most engineering shops these openings are few, and a start must be made at the bottom of the ladder as ordinary apprentices. This must be faced by those who take the college course before the practical work, and a young man leaving college should more often apply for a "job" in a workshop rather than, as he so often writes, "for a position where his training will be of value."

STRENGTH OF OXY-ACETYLENE WELDS.

THE exact strength of a weld made by the oxy-acetylene process is always something of a mystery to boiler makers, and the average boiler maker is usually very cautious in subjecting an oxy-acetylene weld to excessive stresses. At the Twentieth Annual Convention of the International Railroad Master Blacksmiths, held in Chicago in August, Mr. C. J. Fackler, of the American Car & Foundry Co., Jeffersonville, Ind., described some of the tests that he had made on the strength of oxy-acetylene welding, and the results of these tests will undoubtedly be of interest to boiler makers. The Davis-Bournville welding system was used, and five welds were made in 3/8-inch and 5/8-inch round mild steel rods 18 inches long. These were bent on the anvil in the shape of a coil spring.

The rods were given rough treatment, as it was the object to break them if it could possibly be done. There were three fractures in the 5/8-inch piece and one in the 3/8-inch piece, which were due to carelessness on the part of the welder and not on account of the system. Two pieces of 2-inch by 2-inch mild steel were welded together, and after being brought up to a high heat the piece was drawn down to one-fourth of its original size. A slight fracture was found in one corner. The piece was then bent back and forth in an attempt to break it, but no fracture occurred. Mr. Fackler, therefore, expressed his conviction that a weld can be made on 2-inch material, but that a good operator should do the work.

The usual run of work which is used in the shop with which he is connected is on light stock, such as 3-16 inch plates, making welds from 6 inches to 8 feet in length. If the work is placed in the hands of an experienced welder it has repeatedly been demonstrated that reliable welds can be obtained.

EFFECT OF COMPRESSED AIR ON WORKMEN.

IN England, experiments have been made to test the effects of compressed air upon the human organism, by means of a steel cylinder large enough to contain a man lying upon a mattress and furnished with a glass window and apparatus for gradually increasing, and afterward even more gradually decreasing, the atmospheric pressure.

These experiments show that the evil effects experienced by divers and laborers in caissons are due entirely to a too rapid diminution of the pressure on emerging from the diving-bells or caissons. This is explained by the fact that the quantity of nitrogen absorbed by the body rapidly increases with the pressure. When the pressure is too swiftly removed the absorbed nitrogen forms little bubbles in the tissues, and especially in the capillary vessels, with serious consequences that may be avoided completely by a very slow and gradual return to ordinary atmospheric pressure.

EQUIPMENT FOR CHARGING RAILWAY BATTERIES.

THE C. P. R. have installed a complete electrical equipment at their Glen Yards, Westmount, P.Q., for the purpose of charging the railway batteries, and it replaces the old storage battery charging plant, previously used. The plant includes a C. G. E. continuous current generator, 25 kw., 200 amperes, 1200-1150 speed at full load, and 125 volts. This is direct connected to a C. G. E. induction type, 60 cycle, 35 h.p., 34 amperes, 550 volt motor. The speed is, no-load 1200 r.p.m., full load 1150 r.p.m. The displaced equipment consisted of a Royal Electric generator, 10 kw., 110 volts, 30 amperes, with a C. G. E. 10 h.p., 310 volt induction motor having a speed of 850 r.p.m., and connected to a 550 volt circuit.

3,000 K.W. SYNCHRONOUS BOOSTER

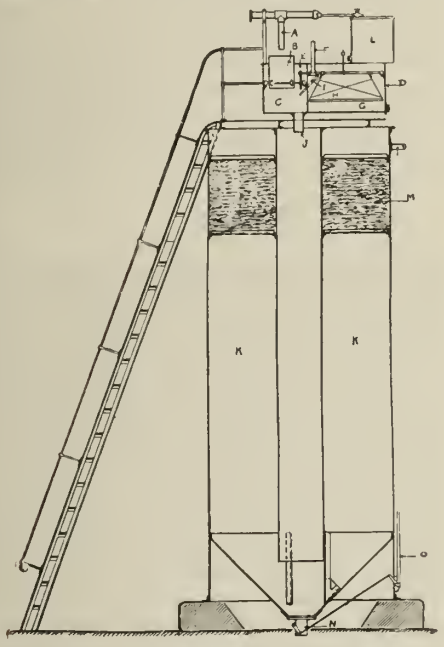
WE learn from Electrical Engineering that two 3,000-kilowatt synchronous booster interpole rotary converters for 25-cycle six-phase working have just been built for use in the sub-stations of the New York Edison Co. The normal continuous current voltage is 270, and the booster allows a 15 per cent. adjustment up or down. The converter armature and frame are mounted above the booster. The commutator is at the top of the machine, and the collector rings at the bottom. In conformity with modern practice on interpole converters, the copper dampers do not extend beyond each pole. The booster poles are shunt wound, and the magnetic field is hand regulated. The commutator is cooled by the insertion of copper heat radiating fins in the upper end of each bar. A roller thrust bearing with the necessary adjustments is arranged at the top of the pedestal to take the weight of the revolving element. Lubrication is effected by a gravity oiling system, the oil being stored in reservoirs and forced up through an oil pipe in the middle of the pedestal.

New Westminster.—The Shaake Machine Works have received an order for the construction of a Rochford dredge to be used in gold dredging operations on the Fraser River, near Hope. The dredge will cost about $30.000, and will be ready early in 1913.

WATER SOFTENING EQUIPMENT.

By a Chief Engineer.

THE pecuniary losses and the dangers due to the presence of scale in boilers are too well known to engineers and manufacturers to require emphasizing. In hard water districts, the loss in efficiency and the frequent and costly Sunday "cleaning-out" are accepted by many steam users as unavoidable. Others resort to boiler compounds, some of which frequently are used indiscriminately without reference to the nature of the impurities in the feed water, and even if proper care be taken to suit them to the feed water, the cost of the compound may be great when compared with the amount of active material present. The basis of many of these compounds is soda and they frequently contain starchy or gelatinous matter which is



VERTICAL WATER SOFTENING APPARATUS WITH STEPHENSON'S PATENT CHEMICAL GEAR.

supposed to serve the purpose of coating each individual grain of scale forming material and thus prevent the particles adhering, a loose mud being formed which has to be blown or washed out. By the use of water treated in a properly designed water softening plant the boiler plates and tubes are kept clean, there is no scale formed or mud deposited and no overheating takes place. A water softening plant should be entirely automatic and should only require a few minutes attention once or twice a day. Such a plant is not high in first cost, and its installation, wherever hard water has to be contended with, is fully justified by the fuel and other savings.

Water Softening Plant Operation.

Fig. 1 shows a section of a water softening plant with Stephensons patent chemical gear, the feature of which is its simplicity, there being no valves or other parts which might get choked. The entire action is continuous and automatic. The hard water is delivered by the pipe (A) into the duplex tipping bucket (B), in the compartment (C) of reagent tank (D). The tipping motion of the bucket is transmitted through the gear wheels (E) to the scoop dipper (F) and agitators (H) in compartment (G) of the re-agent tank (D). The necessary solution of lime and soda for treating the water is placed in compartment (G). In the larger plants a mixing tank (L) is provided, in which the re-agent (lime) is mixed with water, and the milk of lime thus formed passes through an outlet valve into the compartment (G), with soda ash added, if required. In the smaller plants, the re-agents are mixed in a pail and poured into the re-agent tank. As the buckets tip to and fro, the scoop descends into the re-agent solution, and on rising, delivers a definite quantity of this solution into the cup (I), which leads into the compartment (C). Here, the solution meets with the hard water discharged from the tipping buckets, with which it becomes most intimately mixed, and passes down the outlet (J) into the decanter (K). In this decanter the precipitated matter falls into the conical bottom, whence it can be easily removed by opening the sludge valve (N) which is operated by the lever (O). The water rises in decanter (K), passes through the deep filter of woodwool (M), and emerges clear and soft at the outlet (P). A ladder with handrail for the smaller, and a spiral staircase for the larger plants, reaching from ground to platform on top of decanter, gives access to re-agent gear, etc.

From the foregoing description, it will be seen that for every double tip of the bucket, the re-agent scoop descends into and rises out of the solution, of which it delivers a definite quantity of accurate average strength. The shape of this scoop is such that the quantity of solution delivered is always the same, no matter whether the depth of the solution in the re-agent tank be great or small; that is to say, the quantity of solution delivered by the scoop remains constant, while the quantity of solution in the re-agent tank is continuously diminishing. It will be apparent also that the re-agent solution delivered by the scoop is always in the same proportion to the quantity of hard water discharged from the buckets, whether they be tipping fast or slow. This exact proportion is maintained without the aid of valves, syphons or complicated gear of any description. The solution is kept well stirred by the agitators, but should there be any variation in strength at different depths in the tank, the scoop will deliver a perfectly averaged sample of the whole, as it passes through the entire depth of solution at each stroke.

The process is cold, the ground space occupied is very small, and the amount of attention required is less than one hour by one man per 12 hours run. The cost of installing a water softening plant runs from about $300 to $450 for every 1,000 gallons per hour that the plant is to treat, and the cost of the re-agents usually works out at from 2 to 3 cents per 1,000 gallons treated. Taking interest and depreciation at 15 per cent., and figuring on the plant running for ten hours per day or 300 days per year, the average cost of softening a thousand

4,000 GALLONS WATER SOFTENING PLANT.

gallons of hard water comes about 4 or 5 cents.

On page 283 in the October issue of The Power House, Professor E. V. Lallier writes as follows:—

"A layer of scale of a thickness of 1-16 inch causes a loss of 20 per cent., while a scale of 1-8 inch causes a loss of 30 per cent. of the heat of the fuel."

As it takes roughly half a ton of coal to evaporate 1,000 gallons of water, and taking coal at $3.50 per ton, the loss due to 1-16 inch of scale would be 35c per 1,000 gallons, and if the scale were 1-8 inch thick, the loss would be 53c per 1,000 gallons, against a total cost of about 5c for same with water softening. The writer is indebted to Mr. George H. Tod, Engineer, Manning Chambers, Toronto, for the cuts accompanying this Article.

Current Topics

Gas Producers.—In a paper on "The Operation of Gas Producers with Different Fuels," Mr. R. H. Fernald points out that certain types of fuel, such as lignite, permit a high rate of fuel consumption, especially in producers of the down-draft type. Plants are in operation that consume more than 40 lb. of lignite per square foot of fuel bed area per hour, but the majority of producers do not gasify ordinary fuels at any such rate. It is true that suction and pressure producers may be made to gasify comparatively large quantities of fuel per hour for relatively short periods, but in actual operation with ordinary grades of fuel it is doubtful if the consumption exceeds 15 lb. to 16 lb. per square foot of fuel bed area. The normal figure seems to be much nearer 10 lb., although of course, some variation should be allowed for the "workability of the fuel." Even 10 lb. may be a high figure in the case of fuels having a large percentage of ash of a sulphur content that tends to produce serious clinkering.

Zinc Coating.—In order to protect iron objects from rust it is customary to coat them with zinc either electrolytically or by plunging them in a bath of melted zinc after careful cleansing. The disadvantage of these methods is that a real fusion of the two metals is not obtained. As a result, the zinc coating is likely to be attacked by the atmosphere. This may be avoided, says the Chemical Trades Journal, by a recently patented process which consists in so preparing the iron that the zinc gets into its pores. After steeping in sulphuric acid, the iron is placed in a solution of mercury chloride and heated; this resulting in decomposition of the mercury chloride and precipitation of metallic mercury, which forms an amalgam with the iron on the surface. The iron is then plunged into a zinc bath heated to 500 deg., where it remains three minutes. Iron galvanised by this process shows unusually strong adhesion of coating to metal. Microscopic investigation shows that the zinc penetrates into the pores of the iron, and in case a portion of the coating is worn or broken off, the iron does not rust, owing to the presence of sufficient zinc in the pores.

Motor Notes.—Compound-wound motors are best suited for driving planers, slotters, shapers, rolling mills, punch presses, and other machines with a reciprocating motion of either the tool or the work. This is due to the fact that the greatest demand for power is at the instant of reversal of motion, and the series winding causes an increase of torque as the speed drops, due to the increased load at that instant. The load curve of a compound motor may be greatly smoothed out by adding a fly-wheel, and it will tend to lessen the load on the motor. For machines of the class stated, motors of larger capacity are required than for machines operating with a rotary motion and removing the same amount of metal. Fly-wheels, however, tend to reduce the size of motor required for a given machine.

Commutator Slotter.—Like many other companies, the Third Avenue Railway has designed and built its own form of commutator slotter, says the Electric Railway Journal. It consists essentially of a wooden carrier or bed on which the armature is placed, and of a metal stand or sliding carriage for the drive. An unusual feature is the application of the exhaust system of the shops to carry away the ground mica and copper filings. The armature bed rests on two uprights which have hand wheels at their bases for obtaining vertical adjustment. As these uprights are also movable horizontally they can be readily adapted for any length of armature shaft. Variations in the alignment of the commutator bars are corrected by means of small side screws. The saw arbor is belt driven from the countershafting at a speed of about 3000 revolutions per minute. By means of a bent lever, the operator moves the slotter backwards and forwards along the carriage. This machine now handles eight different types of armatures. All commutators are undercut to a depth of 3-32 inches. About eighteen minutes is required for the commutating pole motors, and about twenty minutes for the various older types of motors.

CORRECTION.

IN our October issue, page 269, under the heading, "New British Factory for Diesel Engines," reference was made to its being the largest of its kind in Great Britain. We have since been informed that the latter statement is incorrect and that the works of Mirrilees, Bickerton & Day, Ltd., Stockport, England, are entitled to the distinction. Their original factory, built some years ago for the sole manufacture of stationary and marine type Diesel engines has since been twice enlarged, constituting it the largest and most up-to-date for its purpose as above, in Great Britain.

POWER FOR ROLLING MILLS.

THE power required to drive a rolling mill naturally varies rapidly between wide limits. To ensure that the working costs of a rolling mill should be low, means must be found for reducing the fluctuations in the power required to drive the mill, care being taken in doing this that the capital cost of the plant is not unduly increased nor the possible output reduced.

The variations in power are reduced by employing a fly-wheel in conjunction with an electric motor which is used to drive a rolling mill, and by providing some device for reducing the speed of the motor and fly-wheel to enable the latter to give out some of its stored energy when the demand for power is great, so as to reduce the power which has to be furnished by the motor. When the demand for power is small, the motor will speed up the fly-wheel, thereby replacing its stored energy; this increases the power which the motor has to supply when the demand made by the mill is small, and therefore reduces the total variation in power.

In making the above general observations, it must be borne in mind that the character of the variations in the power required to drive the rolling mill depends on the type of the mill to be driven.

THE THOR IRON WORKS, LIMITED.

THE plant formerly operated by the Canadian Shipbuilding Company at the foot of Bathurst Street, Toronto, has recently been acquired by a company organized by a group of Toronto men. The leading figures in the new corporation, which is to be known as the Thor Iron Works, Limited, are Mr. John Malone (formerly of the Toronto Iron Works) President; Mr. John E. Russell (the well-known contractor) and Mr. Wm Sneath (now associated with Mr. Frank Barber, civil engineer) Secretary-Treasurer. The plant is well equipped for the fabrication of steel tank and plate work, steel roof trusses and light structural work. It is the intention of the new owners, should business conditions justify, to enlarge the scope of the works to cover structural steel work generally. The further fact that the plant possesses a well equipped machine shop and one of the largest pairs of shear legs on the water front, should render it of great service to ship owners for marine repairs. Mr. Russell's thorough knowledge of marine work in general, Mr. Malone's long experience in tank and plate work, and Mr. Sneath's technical and practical aptitude as an engineer, should guarantee the new company's ability to make a success of their undertaking.

The works are in shape now to give immediate attention and quick deliveries on orders in the lines mentioned.

Auxiliary Equipment Between Exhaust Pipe and Boiler

By William Weir

In making publication of this paper in our journal, we are of opinion that no better qualified authority than the writer is available to deal with this particular and highly important subject, and while the data is perhaps more directly applicable to marine practice, there need be no finely drawn reasoning on the reader's part to bring the contents, within his own sphere. Mr. Weir is a member of the firm of G. J. Weir, Glasgow, Scotland, who are famed the world over for their power plant and marine auxiliary machinery.

IN his paper on the "Development of Auxiliary Units Between Exhaust Pipe and Boiler," read before the Institution of Engineers and Shipbuilders in Scotland recently, Mr. Weir first set out the sequence in which the principles involved in the development of auxiliary machinery were originally enunciated, and then considered the practical embodiment of these principles in various forms of apparatus, together with some typical results of performances. In the chain of auxiliary machinery involved in the treatment of exhaust steam from the exhaust pipe to the boiler he included the condenser, circulating pump, air pump, feed-heating apparatus, feed-pumping apparatus, and feed make-up apparatus.

Surface Condensers.

Dealing with the question of condenser design, he said that, if it were assumed, as the result of experience, that the most practical constructional form of apparatus in which the steam and water could be brought into contact was one in which the water passed through a number of small tubes inside a containing vessel to which the steam was introduced, it followed that the province of condenser design lay in the proportioning of the respective paths of the two fluids. The steam path must be such that the maximum velocity was attainable with the minimum loss of head. Obviously, then, the path must be, as nearly as possible, straight, and the velocity must be maintained constant in value.

The first condition precluded the use of baffle plates; the second necessitated a varying cross-sectional area, which should, in fact, vary in proportion to the condensation. The only other factor directly influencing the contour of the steam path was the quantity of non-condensable gases present. Maximum efficiency required that this quantity should be kept at a minimum, and this constituted the function of the air pump. Where one pump was used both as air pump and condensed water pump, the path of the steam would necessarily be identical with that of the condensed water. Where separate pumps were used, however, it would be possible to treat the vapor and water differently, and to give them different paths. Whether it would be advisable to do so or not would depend on whether the transmission rate was affected by the state—liquid or gaseous—of the material on the steam side of the tubes, always remembering that equal velocities were assumed.

Careful experiment and the results of experience had failed to reveal any reaction of this kind on the transmission rate, but practical considerations, which limited the closeness of pitch of tubes, prevented the attainments of high velocities with water except when held in suspension in a gaseous medium. Accordingly, the conclusion was that, in a condenser of homogeneous construction, submerged tubes were not compatible with the highest overall efficiency.

As regards the water path, as there was no change in volume of the water, and as its heat-transferring value, per unit temperature difference, was not appreciably changed during its course, its velocity, and hence the cross-sectional area of its path, should be uniform. The velocity chosen would depend on the mode of variation of the heat-transmission rate with velocity and on the permissible expenditure in obtaining that velocity. The actual quantity of water used would be a matter of compromise between expenditure in its pumping and its reaction on the length of water path required before the outlet temperature which it entailed was attained.

Sectional Drainage.

In condensers possessing sectional or compartmental drainage, it was stated that the water of condensation was intercepted and removed to the hot-well as soon as it was formed; the basic idea being that the heat-transmission rate would thereby be improved and the hot-well temperature increased for a given vacuum. So far as experiments carried out by his firm had shown, no influence on the transmission rate by the interception of this water could be traced, while the claim for higher hot-well temperature was, he thought, no longer supported.

The most interesting feature of this question concerned the means employed to achieve the sectional or compartmental drainage, and the consideration of this involved knowledge of one of the rudimentary phenomena which existed in surface condensers. Necessarily the carrying out of this drainage feature included the sub-division of the condenser by baffle plates or collectors lying approximately parallel to the steam path. Now, the velocity of steam flow in a high-vacuum condenser might be taken as 500 ft. a second, which represented 340 miles an hour, and consideration of this simple statement explained the fallacy of sectional drainage together with the impossibility of its practical achievement.

Another misconception with reference to condenser design concerned the use of what might be termed an inverted condenser—i.e" one in which the steam admission was at the bottom and the air extraction at the top. It had been stated that in such a condenser the steam would not readily rise; but, as a matter of fact, the steam would rise with the velocity already indicated, and, if space considerations permitted the adoption of such condensers, their performance would be quite as good as that of existing installations.

The author also pointed out the extreme difficulty, at present, of accurately recording high degrees of vacua. In the first place, this was due to the almost invariable inconsistencies of the ordinary types of vacuum gauge; and, secondly, to the effect of the high velocity of the steam in the exhaust pipe affecting the readings. These velocity considerations also demanded that careful attention should be given to the design of abnormal shapes of exhaust bends.

Independent Air Pumps.

The most obvious advantage of an independent air pump was its ability to obtain a vacuum in the condenser before the main engines were started, thereby enabling the engines to be manipulated with greater ease and certainty at times when immediate response was of importance. On this account, the first adoption of such pumps was on board war vessels, and later for small river steamers, while the advent of the marine steam turbine made the provision of such pumps a practical necessity. At the present moment, a considerable increase in the adoption of this auxiliary was taking place, even for reciprocating-en-

gine installations, on account of the ever-increasing powers of the vessels, and the necessarily increased risks with greater dimensions and higher engine speeds. The earliest designs of independent air pumps were those in which the pump was driven by an independent crank-shaft engine, and when the very variable and peculiar nature of an air pump load was considered it would be obvious that a very meagre degree of success was possible. Greater success was obtained when the air pump was coupled to the independent circulating-engine, as these engines were under a considerable continuous load, and the variations of the air pump load were not so vital in their effect; but even this arrangement was frequently unsuccessful, particularly where lack of care was shown in the details of design.

Air Pump Types.

The direct-acting independent air pump was originally developed in the United States, while in its details, it was perfected in Great Britain, and in the form of the "Twin" air pump thoroughly satisfactory results were obtained. A further degree of simplification in design was the advent of the "Monotype" pump, in which a single air barrel of the three-valve type was driven by a single steam cylinder, and even now this constituted a very successful type of pump for certain conditions. The suction-valveless pump, the features of which were originally enunciated in 1879, and which was now known as the Edwards air pump, offered distinct advantages, but owing to the principle of working, it was unsuitable for independent drive.

The "Twin" or "Monotype" pumps required to be very large on account of their handling the air and water together and it was early evident that the maximum efficiency would be obtained only by a combination of wet and dry pumps. One of the earliest and most interesting marine examples was fitted to the cable steamer Pacific in 1903, while a similar arrangement was applied to a number of land and marine installations. The water from the condenser was removed by a float-controlled hot-well pump working entirely full of water, and automatically returning the condensate to the feed tank at the temperature due to the vacuum, on account of its being subjected to contact with the entering steam. The air and vapor were handled by a suction-valveless dry air pump of small dimensions, driven at high speed by a prolongation of the piston rod of the circulating engine.

Wet and Dry Air Pumps.

In the early stages of turbine propulsion many forms and combinations of wet and dry air pumps were fitted, but unfortunately these installations, in the majority of cases, were rendered apparently non-effective on account of faulty condenser design, and the present design of Uniflux condenser was a direct outcome of the apparent non-success of the independent dry air pump. However, after a satisfactory condenser design had been found, the field was clear for a fresh application of the wet and dry air pump principle. The main object was to secure a wet and dry pump in one unit, in order to obtain an apparatus of minimum weight and of greater simplicity and steam economy, together with greater reliability, than had been possible with the separate wet and dry pumps. These advantages were offered by the Dual air pump, which secured:—

(1)—A wet air pump working approximately at the temperature due to the vacuum, in combination with a dry air pump working at a much lower temperature, on account of which it was enabled to handle air leakage without any substantial cooling of the main body of feed water.

(2)—A dry air pump, which was of high efficiency, since it was required to discharge against only 4 lb. pressure instead of 15 lb., as in the case of an ordinary air pump.

(3)—Reduction of load on beam, links and levers, owing to the light discharge load on the dry pump, this advantage being reflected in the reduced steam consumption.

(4)—A smaller and lighter air pump for equivalent duty, owing to the high efficiency.

Rotary Dry Air Pumps.

During the last few years much interest had been taken in the development of rotary dry air pumps, especially for electrical station practice on the Continent. For marine use, the adoption of rotary dry air pumps had been comparatively slow. The necessity for driving such rotary machines by small steam turbines, in themselves still more or less in the development stage, necessarily implied high steam consumption, while even the best rotary air pumps required the absorption of a considerable power per unit of air removed. Further, the existing types did not appear to possess any degree of flexibility, in the sense that, being velocity machines, they must always run at the designed speed and accordingly use the same amount of steam, thus causing their performances at low powers of the vessel to be fairly inefficient.

Feed-Water Heating.

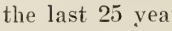
The development in marine feed-water heating in the last 25 years had merely consisted in the adaptation of design to suit the conditions imposed by varying requirements for different classes of vessels. There were only two types of feed-heater—direct-contact and surface.

Broadly speaking, direct-contact heaters should be, and generally were, of universal adoption, on account of their simplicity and of the outstanding advantage of their ability to eliminate the corrosive gases from the feed-water. Their universal adoption was, however, controlled in lighter draught vessels and in warships by the necessity of placing them high up in the ship, and also to a slight extent by a disinclination to mix auxiliary exhausts direct with the main feed on account of the suspected boiler troubles due to oil. In very large ships where the exhaust of single auxiliaries, such as electric-light engines of considerable power, did contain oil in a considerable amount this argument was tenable; but when it was considered that almost 5,000 vessels were now running satisfactorily with direct-contact heaters, many of them 25 years old, and in addition that there were probably more cases of trouble with the oil in boilers on vessels without direct-contact heaters than with them, some other explanation must be looked for in connection with the difficulty.

Direct-contact heaters were necessarily always on the suction side of the feed pumps, while surface heaters were most frequently arranged on the discharge side, though not necessarily so. A discharge surface feed-water heater offered the only method of obtaining very high degrees of feed heating, over say 230 deg. F.

Steam for Feed-Water Heating

As regards the source of heating steam, the essential principle was to use, in the first place, all the auxiliary exhausts and then supplement from the L.P. receiver. In earlier days, the proportion of auxiliary exhausts to the main feed quantity was low; now it had greatly increased. In ordinary cargo steamers these exhausts would on the average heat the feed-water through a range of about 70 deg. F., and in some passenger steamers through a range of 90 deg. F., while in turbine vessels, and especially combination vessels, the range was rendered much higher on account of the increased efficiency of the main installation as compared with reciprocating installations, and also by the additional steam required for independent air and very large circulating pumps, together with the provision of oil-lubricating and water service pumps. These represent increases on the auxiliary exhaust supply, while for the same power the main feed-water itself was decreased.



Mr. T. Aird Murray, consulting engineer, has returned to Toronto after an extended trip through the West.

Installation and Operation of the Small Power Plant*

By Professor E. V. Lallier

We are so much accustomed to associate economy and efficiency requirements with large installations of power generation mechanism only, that those of lesser proportions go for the most part unheeded. That there is corresponding achievement awaiting those who own and operate small power plants is plainly and pointedly indicated in the broad treatment accorded the subject by the writer.

IN our October issue, under the above heading, the features of efficiency and economy, status of operators, leaky valves, combustion of fuel, anthracite and bituminous coal, lubrication, etc., were dealt with. The present and concluding portion of the subject is not only necessarily supplemental, but equally important with what has preceded in the attainment of results.

Miscellaneous Accessories.

The steam pipes should be sufficiently large to carry all the steam which will be required. A separator should be installed in the supply pipe to assure the delivery of dry steam. If the supply pipe of the engine is vertical, the stop valve should be provided with a bleeder in order that it may be drained of water. The governor must be carefully inspected to see that it works free and the safety stops, if present, should be ready for action when the engine is running. Good packing properly applied is essential, for a poor packing or one improperly applied, or one allowed to develop even a slight leak will be productive of a scoring of the piston rod and valve stems which eventually will require their replacement. The adjustment of the valves, guide slippers, cross head and crank pin brasses must be maintained, and in correcting the latter for wear, care must be taken to retain their position relative to the piston, otherwise the clearance may be affected with detriment to the operation if not productive of actual physical damage. See that the piston rings are properly set out, and if any parts are likely to slip out of position at any time mark them, so that if this does occur, they may be accurately readjusted with the least possible delay. It is also well to make a set of trammels for all such parts, marking them clearly for reference.

So far as the electrical equipment under the head of the generators and switchboard are concerned, there is little to be said, except to keep them clean and see that the brushes and commutators are kept in good condition. Any serious damage either to the dynamos or the instruments will scarcely come within the province of the average engineer to repair. A record of the electrical output will prove a convenience in checking the efficiency of the outfit. The voltage should be maintained normal at all times, for a variation above or below will either impair the results produced or is apt to be detrimental to the apparatus.

Reclamation of Oil.

We must not forget the reclaiming of at least part of the oil. Cylinder oil, such of it as may be separated from the exhaust steam, is valueless, as it holds in suspension finely divided particles of hard carbon which will cause it to injure any wearing surface on which it might be used; besides, its vitality, if I may call it so, has been injured by the heat to which it has been subjected. On the other hand the lubricating oil which has been run through the cool bearings may be reclaimed and filtered of any dirt which it may have collected. This reclaimed oil, mixed with some fresh oil, may be used again. Comparatively inexpensive filters are sold for this purpose, and many engineers are ingenious enough where opportunity serves, to make one themselves with the materials at their command.

Feed Water Heaters.

Feed water heaters are an economical necessity on account of the effect of cold water on both the boiler and the coal pile. Cold water should not be introduced into the boiler as the difference between its temperature and that of the water in the boiler, will be productive of strains injurious to the boiler material. Again, the higher the temperature of the incoming water the fewer the heat units necessary to bring it to the steam making point. If we are pumping from the street mains, or similar source of supply, the temperature is low and by the simple expedient of passing it through a heater, the cold feed water will absorb a large amount of heat from the exhaust steam, which is thus compelled to do useful work.

The heater should be carefully selected with a view of the work to be done. The steam space should be large enough to accommodate the exhaust steam supplied, and the water passages large enough for a sufficient supply of water. If one or the other is too large we may not heat the water to the highest possible temperature, or we may not be able to avail ourselves to the greatest extent of the heat units in the exhaust steam. On account of the conductivity of the material, perhaps those heaters containing coils of copper tubes are the best, not only for the facility with which they transmit the heat, but because they readily adapt themselves to the unequal expansion and contraction of the materials employed in construction.

Pumps.

For the purpose of supplying the feed water, we have the steam pumps and the injectors. The former are commonly used when the engines are running and exhaust steam is available for heating. At other times the injector may be used to advantage, but as it heats the water by mixing it with live steam, this is not as economical a method as the pump, wherein the expansive powers of the steam in the engine end of the pump is employed to pump the water handled in the water end. More than one pump should ordinarily be installed in order that while one may be used to feed the boilers, another may be available for keeping clear the returns from the heating system, and another held in reserve capable of being used, for example, to fill tanks, etc. This is a part of the equipment which is too often set up in a place difficult of access, particularly in case a rod has to be replaced.

I have found it advantageous to insist on having the pump rods made of bronze in such cases as the makers did not originally supply them made of this material. Where the water connection is not too large, or where there is a heavy drain on the mains, it is a good plan to connect the supply pipes of the pumps to a receiver, thus assuring a plentiful supply of water.

Supplies Carried.

In the matter of supplies, and not considering such as coal, oil, grease, packing, etc., much time, trouble and expense may be avoided by carrying a fair amount of the materials commonly required with comparative frequency in the maintenance of the plant itself and its connections in the building. The engine room usually has to look after matters in the building connected with heating water supply, gas and electricity; for this reason, among the principal supplies should be motor brushes (if used), arc light carbons, incandescent lamps,

*Abstract continuation of a lecture delivered recently to the General Committee of the Ten Combined Associations of Manhattan and the Bronx.

fuses, etc., a fair assortment of valves, pipes and fittings of such variety and quantity as previous experience has determined may be ordinarily required; also such tools as are essential for doing the ordinary work should be at hand. The first cost of all this is not as great as it sounds, and it will pay for itself many times over when an emergency arises.

Purchase of Supplies.

Supplies should be purchased with intelligence and discrimination. Some time ago, the daily papers had much to say about a five-foot shelf of literature. I say that every engineer should have in his engine room a five-foot shelf of catalogues covering articles pertaining to his calling, and that he should familiarize himself with their contents. Many catalogues are extremely valuable on account of the rules and formulae which they contain; also the descriptions of the articles sold and instructions for their use are valuable. When anything for the plant is required, the engineer should inform himself in detail as to the articles which appear best fitted to meet his requirements. He should then obtain the best prices and discounts possible. If he is not already familiar with the particular article he should make it his business to visit some plant where it is used, after which the purchase should depend, if possible, strictly on the merits of the make of article selected, for the price, as before stated, is not always strictly an indication that a given article is the best for the required purpose.

If the quantity ordered affects the price, this must be considered in some cases. For example, if the building consumes on the average 25 incandescent lamps per month, then it is best to buy a year's supply and take advantage of barrel lot prices; but if you use two ½ in. elbows a month, it would not be well to buy 100 lbs. of them because of an added 10 per cent. discount, for then you will tie up for a long time more money than the saving in cost amounts to. Again, while you might buy a quantity of sheet packing, used for various purposes, it would not be well to buy two dozen rolls of tape, for a large part of it would deteriorate before you were ready to use it. Neither would you buy fifty barrels of oil if you are using two barrels a month, but you might have an agreement to purchase fifty barrels of a certain standard at a given price, these to be delivered two per month, or as they are required.

Proper Records Essential.

A neat and compact method of keeping track of the cost of the various materials purchased is a small card index. A box containing the alphabetical markers and a package of cards may be purchased for 35 cents, and it is but a moment's work to enter on a card items like this: "Hack saws, 8-in., doz. 90-30 & 10.60," and place in the box. The next time we wish to know the price of 8-in. hack saws we don't have to look it up in a catalogue and figure discounts, as it is all here on a card back of letter S. Also it saves time in checking future bills.

Besides concentrating your purchases for quantity, try to do so for your own convenience and that of the employer. For example, while it does occur that some article may be required, the immediate need of which has not been foreseen, yet, the very fact of having your supplies kept in order will enable you to learn what kind and quantities will be required for a month to come. Prepare for this by having a small book in which you may note the fact whenever a certain supply is running low and once each month submit a requisition covering everything required for the coming month. This will avoid much friction, as the employer is more likely to prefer this systematic method rather than to be bothered every day with requests for this or that individual article.

Changes in Equipment.

If, after due consideration, some radical change in equipment appears to be necessary, do not hesitate to bring the matter to the attention of your employer; but remember he is a busy man, therefore place it before him in written form, state briefly what you wish, and the reasons for doing it; also if possible state what it will cost. He will invariably give such a request his attention, whereas a general verbal and indefinite request, accompanied perhaps by a lot of unfamiliar catalogues through which you expect him to wade and look up figures and facts—all more in your province than in his—will be laid aside until he has time to take it up. This time rarely comes; besides, lax methods reflect upon your ability as an engineer.

Again let me impress on you the necessity not only of knowing what you want but of stating clearly why you want it. In a certain plant a rather intricate set of piping for a particular use required renewal about every two or three months. It took two men nearly two days each time to make the change during which time that part of the plant was seriously incommoded. The engineer noted that a brass pipe under the same conditions did not break down, but hesitated to make the change to all brass, on account of the first cost. However, on presenting the matter clearly he was told to go ahead, the change was made and the same pipes are still in use, apparently as good as when put in two years ago. Time was saved and delay avoided.

GAS ENGINE FOR HYDRAULIC LIFTS.

THE First National Bank Building, Columbus, Ohio, contains a novel combination of centrifugal pumps, driven by gas engines, for working hydraulic elevators. The structure is a ten-storey office building, containing two passenger elevators, having a capacity of 5,000 lbs., and running at a speed of 500 ft. a minute, which are in operation almost constantly from 6,30 a.m. to 9.30 p.m.

When first installed, the elevators were served by one 9 in. by 12 in. triplex double-acting pump, driven by a 75 h.p. motor and controlled by a regulating valve which maintained a pressure of 140 lbs. Power was purchased from a public service company at 3 cents per k.w. hour, and under these conditions the average cost of operation was $11.50 a day. In addition to the high cost of service there was also serious objection to the noise of the pump gears, and it was decided to replace the electric motor and the triplex pump by a gas engine and a multi-stage centrifugal pump. Since the alterations were made the plant has been in service constantly for four years for an average of 15 hours a day.

The pump is a four-stage unit, and has a capacity of 600 gal. per minute, against a head of 333 ft. The engine has four cylinders, and develops 100 h.p. at a normal speed of 250 r.p.m. It is controlled through a by-pass valve in combination with a special device on the engine mixing valve, the action being such that when the pressure in the high-pressure tank rises above normal, the fuel and air supply is reduced. Natural gas is used for fuel.

The first cost of the gas engine and pump equipment was approximately $5,000, and the total operating cost under present conditions averages $62 a month, as compared with nearly $300 when electric current was purchased.

STORAGE OF COAL IN WATER.

IN order to provide against the risk of a shortage of coal through labor or other causes, the Omaha Electric Light and Power Co., Omaha, Neb., have built a submerged storage pit capable of holding 6,000 tons of coal under water. The purpose in placing it under water is to avoid loss in calorific value by exposure to air and to prevent ignition by spontaneous combustion. Last winter the company were called upon not only to maintain their own service but to sup-

ply coal for household consumption and for some outside refrigerating plants. With this in mind, the pit has been arranged so that a maximum storage of 10,000 tons is possible.

The floor of the pit is carried on piles which are driven through earth and quicksand to solid rock, and are capped by concrete blocks 30 in. square and 12 in. thick. The piles are driven on 5 ft. centres under the entire floor area, the object being to have all the weight of the coal taken by them and not by the earth. The rock is from 25 ft. to 35 ft. below the surface of the ground, while the distance from the floor of the storage pit to the ground level is 14 ft. The pit is placed near the power-house, and between it and the power-house are two receiving hoppers, over which runs a siding from the railroad. A traveling grab bucket crane is placed over the hoppers and the pit, one end running on a girder on the power-house and the other on the top of a concrete wall about 26 ft. above the ground level.

The cost of the entire installation was about $30,000, of which approximately $8,000 was for the foundation work.

WATER POWERS OF BRITISH COLUMBIA.

A GOOD example of what can be done in developing and, at the same time, conserving water-power resources is given by the Jordan River plant of the British Columbia Electric Railway Co., on Vancouver Island. Although the average precipitation over its watershed reaches the excessive figure of 80 inches, the Jordan River, like the majority of our streams, has a wide variation between summer and winter flow. The company has had the flow of this river systematically gauged since 1907, and the results obtained justified the building of large storage reservoirs for the purpose of impounding waters which would otherwise go to waste. The total capacity of these reservoirs, of which there are five, is 1,500,000,000 cubic feet, and they provide ample storage, within reasonable cost, for an ultimate maximum plant output of 24,000 h.p. to 36,000 h.p.

THE A.S.M.E. MEETINGS IN GERMANY.

The plans for the midsummer, 1913 meeting of the American Society of Mechanical Engineers with the Verein Deutscher Ingenieure, which will include the most remarkable tour of the industries in Germany ever offered to American engineers, are being gradually developed. Mr. Conred Matschoss, Lozent of the Royal Polytechnic High School of Berlin, has been visiting the United States as a representative of the German Society and has been conferring with the committee of arangements regarding itinerary, professional papers, etc.

In general, the date of the departure from the United States, will be June 11, and arrival will be made in Germany, on Saturday, June 21. There the party will be received by the municipal authorities at point of landing and will be given an opportunity to visit the great shipyards before going on by special train to Leipzig, the same or the following day. Sunday evening, June 22, will be the occasion of an informal gathering to promote acquaintanceship, preceding the more formal opening on Monday, June 23. At this opening, there will be a welcome by the King of Saxony and the municipal authorities of Leipzig, and two addresses, one by a representative of the German and the other by a representative of the American society, will be given on general subjects, such as the history of engineering, the relation of capital and labor, and the effect on industry of technical education. Tuesday, the last day to be spent in Leipzig, will be devoted to technical papers and to various social events and participation in the patriotic gathering in commemoration of the battle of Leipzig, of which this year is the one hundredth anniversary.

The party will leave on Wednesday for a tour of industrial Germany visiting the principal cities, such as Dresden, Berlin, Dusseldorf, Cologne, Frankfurt, Nurnberg, Munich, etc. In all probability, the Krupp works at Essen will be thrown open to the party, the Baroness von Bohlen (geborene von Krupp) receiving the visiting American engineers in person. The trip up the Rhine from Bonn to Rudesheim will be made by boat and at Rudesheim there will be a grand festival on the embankments. Independence Day will be celebrated at Frankfurt, under the auspices of the American Embassy.

The final meeting will be held in Munich, July 7, in connection with the Museum of Technical Arts, of which Dr. von Miller, is the director. It is expected that the Prince of Bavaria and the Mayor of Munich will also receive the party. The entire trip through Germany and the various official receptions are being arranged by a committee of the most important men of the arts and sciences in the German society, and there is the keenest interest shown by municipal authorities and the heads of industrial establishments.

June 29. — Dusseldorf. Reception by the Rhine-Westphalian section of the Verein.

June 30 to July 2.—Various functions arranged by the Rhine-Westphalian section, including a trip to Cologne and Essen.

July 3.—By railway to Bonn. By boat up the Rhine with festival at Rudesheim. By rail to Frankfurt, arriving about 6 p.m. Evening, reception of welcome at Frankfurt.

July 4.—Independence Day at Frankfurt.

July 5, a.m.—Nuremberg.

July 6, p.m.—Munich. Evening reception of welcome.

July7, a.m. — Visit to the German Museum.

July 7, p.m.—Trip on the Starnberg lake.

Evening. — Final exercises in the Rathaus.

GRAPHITE REMEDY FOR BOILER SCALE.

A VERY finely powdered graphite, placed in a boiler immediately after it has been cleaned, circulates with the water, and rubs against the steel, to which it imparts a graphite finish or polish on which scale does not readily form. When this initial dose is regularly followed by smaller doses, the graphite, by mechanical, not chemical, action gradually softens and disintegrates any old scale that may still be present, and if new scale thereafter forms, and it almost always will to some extent, it forms in and with that scale, so that all may be easily broken up and removed. Inferior grades cannot with safety be allowed into steam boilers.

The graphite in cheap grades is impure, containing, perhaps, only 20 to 50 per cent. graphite carbon. The impurities consist of clay, silicate, etc., which means that for every 100-lb. used there would go into the boiler from 50 lb. to 80 lb. of scale-forming substance, which, with the impurities in the feed-water, would be too much for the 20 lb. to 50 lb. of graphite carbon to influence. The cheap grades are, also, coarsely ground. Graphite, to do the work properly in a boiler, should be so impalpably fine that is will remain suspended in the water and circulate with it. Amorphous graphite gives the best results, both for lubricating and for removing and preventing scale. Flake graphite will not do the work as well. The graphite mined in Mexico is said to be the best for steam boilers.

A Paint for Boiler Fronts, which is said to have given satisfactory service, is made by mixing together equal quantities of pure turpentine and a good quality of coach varnish, then adding enough drop black to the mixture to give it a deep black color.

COMBINED PUMPING AND LIGHTING STATIONS.

THE economy to a city resulting from combining its pumping and lighting stations was discussed recently by E. Macdonald, superintendent of the Lincoln, Ill. Water and Light Company, before the Illinois Water Supply Association. The text of his remarks is published in the proceedings of the association, and is abstracted herewith:

Cost of Pumping by Steam.

Last year I undertook to get some information about the cost of pumping water by steam in the average town in Illinois. With that object in view, I sent to a good many cities a letter of inquiry, with a list of questions. The only cost question included was the cost of fuel and station labor required to pump 1,000,000 gals. of water. When the answers were received I began to wish I had not started. The results were amazing, the city reporting the highest cost being more than 1,200 per cent. higher than the one reporting the lowest cost on those two items. A good many of the results were not used, as they were not complete, but there were about 35 replies which were very intelligible, and from them I assumed an average town. I then undertook to compare these costs with the cost of pumping by electricity in a plant like the one at Lincoln.

The result was this (I will not attempt to give very exact figures): It proved that if the electric lighting plant were put with the water plant in such an average town, the price which it is now costing the water company to pump with steam—that is, the cost of fuel and station labor — if paid to the lighting company, would amount to more than 5 cents per kilowatt hour for the current.

It is a well-known fact that lighting companies are on the lookout for power, and they will sell current off their peak load at a much lower price than they would demand for lighting; that is, provided the power load is kept off from what is to them their lighting peak load. It is true the lighting company will make a price for such power uses considerably below 5 cents in many instances with good profit. The question immediately arose, could the lighting company make such a contract with water companies. No. Because the water company is also liable to a peak load which is entirely different from the peak load of a lighting company. For this reason, a lighting company peak load can be estimated very closely and the time of its occurrence can be told in advance almost to the minute.

The pumping station peak load no man can estimate or tell when it may occur; how great it may be or how long it may last. In fact, it may never come, but the pumping station must be prepared for it. That peak load occurs when a dangerous fire breaks out. So the water company could not expect to obtain from the lighting company the same price per kilowatt hour given to manufacturers or other people, who will contract to keep off the peak load. In that case, the water company would probably realize no economy, for they would still be required to keep the pumping station in good condition and have at least one man in attendance in case of fire during the evening hours.

On the other hand, supposing the lighting company had an excess of power and were willing to assume the liability of a double peak load, even then, there would probably be no great saving, for the water company could not safely abandon its steam pumps as there would be danger of an electric breakdown in time of fire, which would prove disastrous. So it seems that the only really economical method of pumping water by electricity, which would show a considerable saving over the cost of pumping by steam in the average town, would be to combine the lighting station and the pumping station.

Location of Pumping Station.

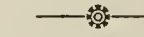
The location of the pumping station is generally fixed by the source of water supply, but electricity can be manufactured in the valley as well as on the hilltop. Therefore, the logical way would be to move the electric lighting station into the pumping house. The only extra equipment necessary would be a power pump, and there would be a gain in the boiler capacity. Were this arrangement properly carried out, it can be very readily figured that it won't cost anything to pump the water.

Some smile at this statement, but when you come to consider the saving in all ways, that is a fact. In the first place, it is true that modern lighting companies can produce power cheaper than the average pumping station. This is due, I suppose, to the fact that the lighting companies have been subjected to very sharp competition with gas, gasoline and acetylene for lighting, and with steam, gas and gasoline for power. Lighting companies have been compelled by force of circumstances to abandon all their old machinery, so that to-day we can hardly find a plant in the country but has been completely rebuilt during the past few years. Pumping stations that have no competition are still using the same machinery they have used for the last fifteen or twenty years. Another reason why electric companies can furnish the power needed for pumping cheaper is that the pumping station labor may be entirely eliminated.

Discussion Data.

The following data were given by Mr. Dabney H. Maury in discussing the foregoing paper: It would probably come as something of a shock to the average waterworks man to know that he could turn over his pumping to an electric company at 5 cents per kilowatt hour and save money by doing so. I have no doubt that Mr. Macdonald's statistics will prove the conditions to be as he has stated them. One does find exceedingly poor economy in the average pumping station. It ought not to be so. The fact that there is no competition ought not to so result, because the difference between loss and profit should be a sufficient incentive to work for better results than are shown by Mr. Macdonald's statement. It is a fact that an electric lighting plant, well equipped, could do pumping at a considerable profit at 5 cents per kilowatt hour, especially on a load more or less uniformly distributed throughout the 24 hours. I personally know it to be the case, because I have an instance in mind where a contract will soon be signed for pumping water by electricity at various plants distributed from 3½ to 6½ miles from the electric power station, with an aggregate use of power of about 100 kilowatts, and where the rate will not exceed 2 cents per kilowatt in December, and there is reason to believe that the rate at all other times will not exceed 1½ cents per kilowatt hour.

The small size of the units in the average pumping station, as compared with the large units in electric power plants, militate against good economy, but Mr. Macdonald's figures, as he states, are based upon inquiries made of large plants as well as small ones, and the size of the pumping engines in the larger plants ought to be at least of such size as would give far better economies than those he has stated.



The John McDougall Caledonian Iron Works, Ltd., Montreal, with whom the Allis-Chalmers-Bullock Co., of Rockfield, Que., had a merger of sales interests, will, in view of the Canadian General Electric having taken over the A. C. B. Co., in future maintain an independent sales department.

Good machine shop foremen are not easy to obtain. It is just as well to keep a good man when one has him; it is also well to make sure he is a good man before one keeps him.

Regrinding Valves

THE ever-increasing demand to-day by power plant owners and steam users in general is for valves that will give absolute reliable service and dependability

Removing Union Ring

under high pressures and severe conditions, and that are free from unnecessary renewal of discs and repair parts. To meet this demand the Penberthy regrinding valve has been designed. It is the result of many years of practical experience in the manufacture of high-

Inserting Pin

grade brass goods, and embodies the latest mechanical constructional ideas. It is claimed to be the heaviest regrinding valve manufactured, and the distribution of metal is such that parts subjected to the greatest strain and wear have proportionately heavier walls. For

Applying Oil and Emery

the present there is only illustrated the medium pattern type, which is guaranteed to stand a constant working pressure of 200 pounds.

Constructional Detail.

A sectional view of the regrinding valve is illustrated herewith, which will give the reader an intelligent idea of the design, construction and general features. It will be noticed that the restrictive areas are largely in excess of the area of the pipe. The long sweep of the body permits easy flow of steam or liquids, thereby reducing friction to a minimum and giving long life to the body. The pipe threads are long and have the full standard depth, while the hexagon ends of the body have large and

Regrinding

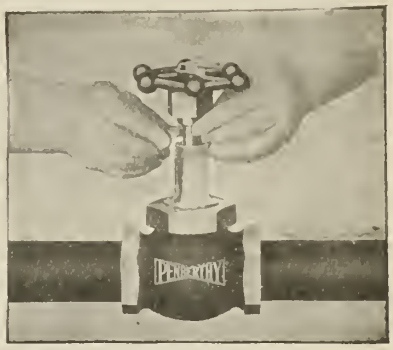
heavy faces. This heavy construction with the increased thickness of metal in the wall near the hexagon insures against the severest of strains.

The union hub ring is extra heavy, and secures hub to body, making a steam-tight and rigid connection. The threads on the hub end of the body being on the outside make the above connection absolutely non-corrosive and permit free accessibility to the valve at any time

Removing Packing Gland

without strain or injury to same. The method used in securing the stem to the disc is novel, for in order to remove the disc from the stem it is only necessary to place the small square on the bottom of the disc in a vise or wrench and unscrew same by means of a wrench.

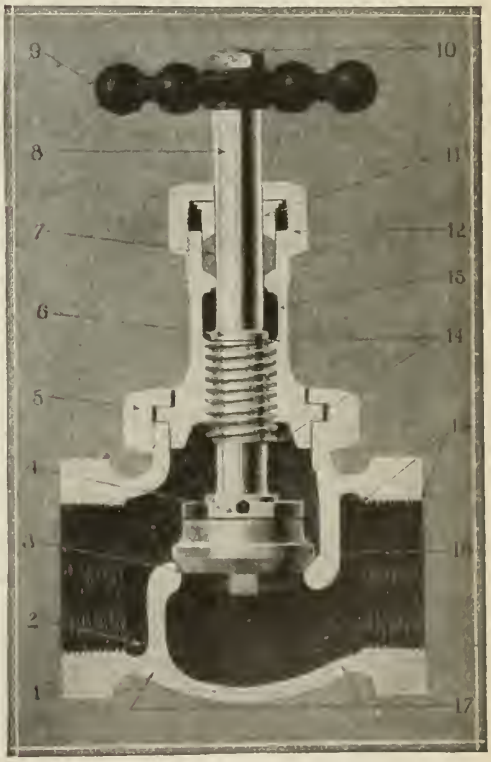
Attention is called to the threaded part of the stem, which also is a feature of the Penberthy regrinding valve. All threads are of full depth, clean-cut and true to standard. They are so designed that every thread is utilized when opening and closing valves, thereby overcoming all danger from "stripping" threads.



Repacking

Method of Regrinding.

The method of regrinding, as illustrated herewith, is a simple operation, and can be accomplished by first removing the union ring or nut which fastens the trimmings to the body of the valve. This is easily done, as the threads which hold the ring to the body are outside of the latter, and are immune from corrosive action of scale or lime. When this is done, insert pin through the slot in the disc lock nut and hole in the stem, which firmly secures the disc to the stem. By applying a little oil and fine emery, or if this is not available, a little soap and fine sand to this disc, and returning the trimmings to the body, the valve is ready for regrinding. To regrind, allow the bottom of the hub to



5¼ INCH SECTIONAL VALVE

work in the neck of the valve body, slightly elevated from the top, so as to cause the disc and seat to come in contact with each other, and by rotating the trimmings back and forth the regrinding operation is accomplished. Care should be taken that all abrasive or foreign materials are removed from seat and disc before and after regrinding, also that small inserting pin is removed before putting trimmings back in place. When reground, the valve is as good as new, at practically no additional cost.

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THE SMALL DIESEL ENGINE.

ONE of the incomprehensible features of the Diesel motor, to those who have become interested without being intimately acquainted with the difficulties of design, is that for smaller powers, where the engine would have such a large field, very little progress has been made. A motor working on the pure Diesel principle of about 100 h.p. upwards would probably receive much attention and have an extremely wide sale were it in a position to compete in every way with all other types. The semi-Diesel engine with hot bulb ignition is a very useful motor, but it is questionable if it will receive wide adoption in its present design for powers above 150 h.p.

It cannot, of course, be said that Diesel engines are not built for low powers, for there are several types which have been put into operation, but up to the present very little has been done. It may be argued that with semi-Diesel engines having very little higher fuel consumption than the pure Diesel type, the latter is not necessary so long as the former are capable of being built for the power. There is no doubt, however, that the Diesel engine would present advantages, and it is by no means certain that it will not eventually replace the other construction.

Engine Must Be Valveless.

The main objections to Diesel motors as at present built by most manufacturers in the application for small work are their relative high cost and comparative complication. It seems, therefore, that to make much headway in the small type, great simplicity must be aimed at (since this is already attained in the semi-Diesel motor), and also the cost of production must be low. When the point of simplicity arises we always turn to an examination of the valves and the question of their abolition as far as possible. This brings us to the fact that a successful small Diesel engine should of necessity be of the two-cycle type, with ports for scavenging instead of valves. With this design, even in spite of the compressor, such a motor is not much less simple than a semi-Diesel engine, and although its cost would be somewhat more, the difference with the same scale of production should not be prohibitive.

In a relatively small motor, where all the dimensions are low, and where the speed must necessarily be high compared with the larger engine, it is advisable from many points of view to avoid the use of details subject to wear. If, therefore, these conditions cannot be complied with, the possibilities of success are not great. It is rather difficult to say at what minimum power it might be economical and commercial to build Diesel motors of a type in which no attempt is made to dispense with as many valves as possible, but we should say that the field for the small Diesel motor built in the style of the large engines with many valves is not a particularly promising one.

Suitable Speed.

The question of speed is an important point, and it is probable that this will be somewhere in the neighborhood of that of a similar semi-Diesel engine, that is to say, a 100 h.p. motor would run at about 300 r.p.m. The weight at this speed, allowing for the compression and accessories, is an unfavorable factor, and heaviness is one of the chief retarding factors in the development of the small Diesel engine. How far weight reduction can be continued in this type of motor is not yet by any means easy to say, but indications point to the fact that most motors have up to the present been built considerably too heavy, although there have been notable exceptions in the other direction.

From the foregoing it may be gathered that the small Diesel motor is not likely to develop exactly on the same lines as the large type, and that many modifications of an important nature may be anticipated; in fact, it is quite possible that the successful commercial motor of the future in powers of 100 h.p. to about 400 h.p. may be a very modified design, with some of the features of the Diesel and some of the so-called semi-Diesel motor. As bearing out this suggestion, it may be mentioned that the low-powered Diesel engines which are now being built are of a special type.

The Need for Simplicity.

One reason for which it is desirable that the small size engine should be made as simple as possible is because the attention it may receive is very small. Many purposes for which a small Diesel engine is conveniently suited, do not necessarily involve the employment of skilled engineers, and plant owners are naturally frightened by anything which appears to them unnecessarily complicated. No doubt, one of the reasons that the semi-Diesel engine has made such headway is that its appearance is fairly simple. This matter of complication is perhaps of even more importance than would otherwise be the case, owing to the fact that the field for the 100-400 h.p. engine lies largely in the Colonies and other parts of the world where it is extremely difficult to get expert attendance. The question of repairs is also one of difficulty in these cases, hence a thoroughly reliable engine is of the first importance.

Taking into consideration the many uses for which the type of engine under discussion is suitable, we think it might be to the interests of some of the firms who are now taking up the construction of the large Diesel engine to turn their attention to the smaller motor. As a matter of fact, we have reason to believe that something very definite will be done in this direction in a short time in several quarters.—Motor Ship.

—⚙—

C. J. PEPPIN HONORED BY HIS CONFRERES.

AS a recognition of his services as secretary of the convention committee of the C.A.S.E., the members of Belleville Lodge, No. 34, on a recent date, presented Mr. C. J. Peppin, past president with a gold watch. An address was read by Mr. F. H. Chesher, and the presentation of the gift made by Mr. Wm. Corham. The address was in part as follows:—

Dear Sir,—It is now some time since the annual convention of the C.A.S.E. was held in this city under the auspices of Belleville Lodge, No. 34, and we have had an opportunity of ascertaining the result of the meeting. Reports indicate that it was highly successful, both numerically and financially. We appreciate the fact that all of the members of our lodge assisted nobly in carrying out the arrangements and in making the convention the unqualified success which it was.

We feel, however, that to you as secretary of the convention committee, the great bulk of the work has fallen, and we realize that the success of the undertaking depended to a large extent upon your efforts. The result indicates that in choosing you for the position of secretary we made no mistake, and we now wish in some small way to tangibly express our appreciation of the valuable services which you have rendered. Will you, therefore, kindly accept this watch as a small token of our appreciation, and may it ever remind you of the feeling our lodge holds towards you. We trust that you may long be spared to meet with us and to take an active interest in our undertakings.

Signed on behalf of Belleville Lodge, No. 34, Canadian Association Stationary Engineers, Frank H. Chesher, executive conductor; Elijah Beal, conductor; Wm. Gorham, treasurer.

The "Bawden" Steam Pump

By Calliope.

THE Bawden'' steam pump being manufactured in Toronto by the Bawden Machine Co., Toronto, embodies in its design many features of interest to power plant engineers and those connected with steam and hydraulic installations generally. It is the outcome of 24 years' practical experience of steam pump design and manufacture, and presents, as its leading feature, simplicity of detail. The Bawden Machine Co. have secured the patent rights together with the services of Mr. Atwood, the patentee, whose record and extensive experience of pumps generally reflects success for this new achievement in the Canadian power field. The writer had the pleasure of seeing a trial pump in action, and, needless to say, was favorably impressed with its work.

The main idea, that occurs to one on close examination of the design and constructional detail are the concentration of effort apparent in furnishing the operating engineer with a simple and reliable mechanism, whose individual parts are easily accessible, thereby avoiding long delays for examination and repairs; and the subdivision of these parts so as to reduce cost of renewals in case of accident by frost or otherwise.

Detail of Construction and Operation.

The ''Bawden'' pump is governed by two piston valves which are a ground fit and are controlled by the action of live steam only. All tappets, levers, springs, rock shafts, tubes or other extraneous gear are dispensed with. A special feature of the piston valves is the arrangement for catching leakage of steam due to wear and tear, thus preventing the valves from getting into equilibrium at their driving ends, and resulting in a longer period through which they will work without repair. The steam piston is automatically cushioned at each end of the cylinder by a special design of the two main steam parts, dispensing with all adjusting mechanisms. There are no dead centres and there is no tendency to hang up. Claim is made also that it cannot be held up. It will run under full load at the fastest and slowest speeds, thus providing the engineer with a flexible pump for all purposes. The firm are making three types which are illustrated by the accompanying cuts:—

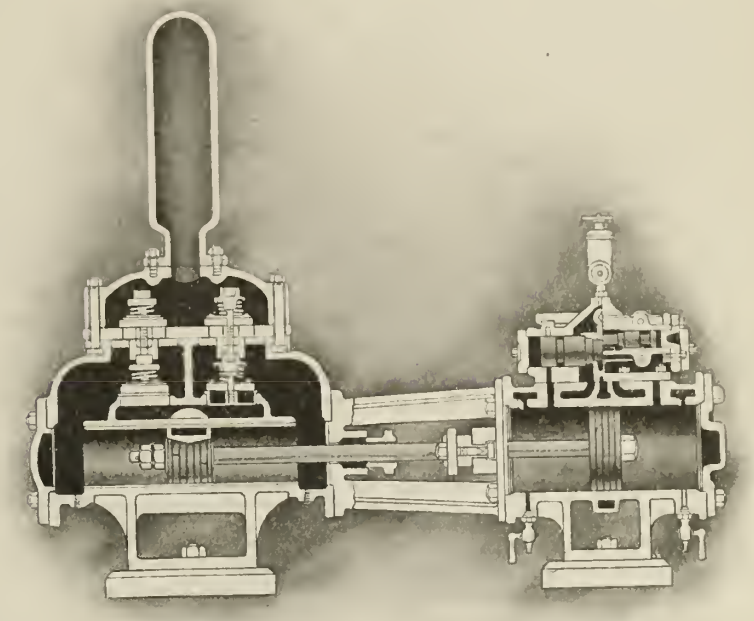

FIG. 1. THE "BAWDEN" PUMP FOR MODERATE PRESSURES AND VACUUM SERVICE.

Fig. 1 represents the regular line suitable for moderate pressures and vacuum service. These have packed water pistons, brass liners, and valve seats which are driven into taper seats and held in with brass stoppers accessible through handholes.

Fig. 2 also represents a pump with packed pistons but with outside valve boxes containing the water valves, each one accessible by removing top cover. This pattern presents special features, as all parts subject to pressure are cylindrical and consequently of great strength. In addition to the cost of renewals being less expensive, and the saving of time in examination and repairs, obstructions in valves are easily located and removed without disconnecting water pipes.

Fig. 3 shows the centre packed ram series, an attractive type for all high pressure work. This pattern favors a short stretcher, the piston rod is cottered into the ram and the valve boxes are bolted to the working barrels, a combination of good features, enabling pump valves to be easily examined, and leakage by packing glands to be always visible. All parts subject to pressure are in this type also cylindrical, consequently it has the advantages enumerated for Fig. 2.

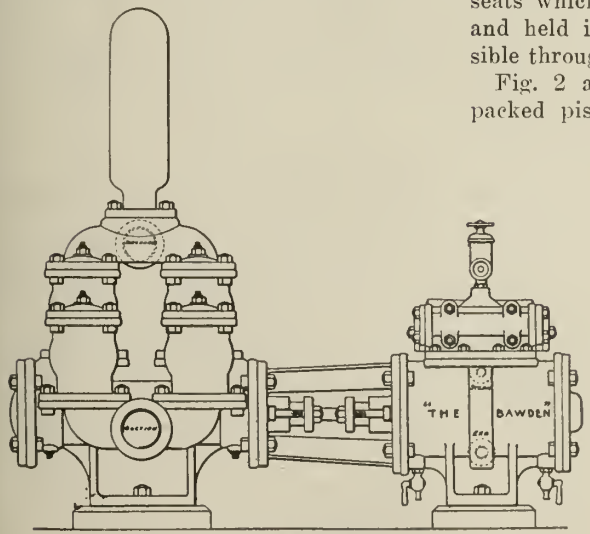

FIG. 2. THE "BAWDEN" PUMP WITH PACKED PISTONS AND OUTSIDE VALVE BOXES.

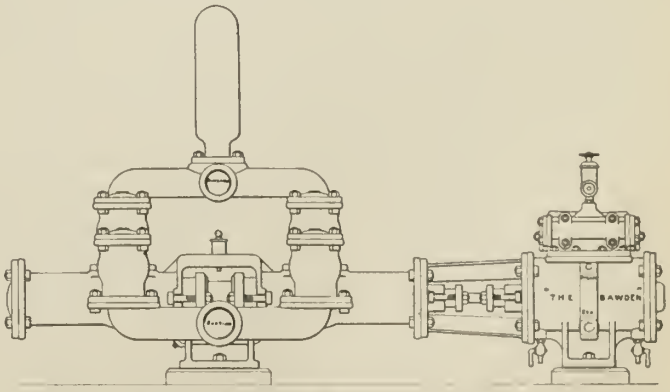

FIG. 3. THE "BAWDEN" CENTRE PACKED RAM PUMP.

In a conversation with Mr. Attwood we learned that his valve motion is equally satisfactory on compound cylinders of his design, and that in the near future we will have the opportunity to illustrate this type for boiler feeding and other purposes. The "Bawden" pump is specially adapted to vacuum heating systems, among many reasons being the absence of lever valve motion enabling the longest stroke pump to be used, a consideration which every engineer knows to be the best for producing the highest and most constant vacuum at moderate piston speeds.

The "Bawden" Compound Pump.

Where greater economy of steam is desired, compound pumps embodying the same valve gear as used on the simple units, are of course recommended. The high and low pressure pistons work in one cylinder, the steam and exhaust parts being of the shortest possible length and so arranged that the high pressure steam never leaves the cylinder casting, while exhausting into the low pressure cylinder. There are no external passages, therefore, radiation and condensation are reduced to a minimum. Only one steam chest is required with one valve to distribute the high and low pressure steam, the whole forming a most compact, reliable and economical pump for boiler feeding, fire service and general purposes. The "Bawden" compound pump will run at speeds varying from the very slowest to the fastest without any mechanical adjustments for cushioning the pistons.

COAL VERSUS OIL.

IN the course of his annual memorandum, Mr. C. E. Stromeyer, the chief engineer to the Manchester Steam Users' Association, gives some notes on the use of oil as fuel, as well as on the question of oil and gas in internal-combustion engines.

Oil for Raising Steam.

He remarks that it is difficult to make a comparison of prices, for according to quality and locality the value of coal varies from, say, less than $2.50 for slack near the colliery to well over $5.00 for good coal in towns, but he gives the following table, which shows the prices above which good coal would have to rise before it would be commercially profitable to burn crude oil instead of coal:

EQUIPMENT.	—PER TON—					
Crude oil for Diesel engine	$ 8.75	$10.00	$11.25	$12.50	$13.75	$15.00
Petrol oil for Diesel engine	11.00	12.50	14.00	15.50	17.25	18.75
Coal for producer gas engine	3.00	3.50	3.75	4.00	4.50	5.00
Coal for gas-fired boiler	2.00	2.25	2.50	3.00	3.25	3.50
Coal for steam engine	2.50	3.00	3.50	3.75	4.00	4.50

Thus, the price of coal would have to rise enormously, or the price of crude oil would have to fall, before it would become profitable to burn the latter. It is reported that the Admiralty recently placed an order for 200,000 tons of shale oil at $12 per ton. Even if the prices of coal and oil should come into harmony, the latter fuel is not quite so advantageous at would at first sight appear. With suitable sprayers the thermal efficiency is doubtless relatively high, but at best this will allow of a gain of only about 5 per cent., and against this has to be set the disadvantage that high efficiencies are associated with high furnace temperatures and also with such boiler troubles as bulges, grooves, etc., especially if the boiler water is at all sedimentary or greasy.

Advantages of Oil Firing.

Two very important advantages of oil firing are the ease with which it can be regulated, and the absence of ashes and clinker; on the other hand, oil must be burnt in brick-lined combustion chambers, which suffer severely from the intense heat and have to be frequently repaired and renewed. If these brick chambers are built into the furnace flues, they have to be pulled out annually in compliance with the Factory and Workshops Act.

During the recent coal strike in England, many steam users fitted sprayers to their furnaces, which delivered the oil upon the bed of coal on the grate. Generally the results were as satisfactory as could be expected, but there were quite a number of gas explosions in the flues. These were due to the escape of unburnt oil which had become vaporized in the warm flues and was there mixed with air; any spark which might stray to a remote corner of the flue where this explosive mixture had formed would ignite it.

Internal-Combustion Engines.

Roughly stated, a first-class modern steam engine utilizes about 12 per cent. of the available heat in the coal, resulting in, say 1.6 lb. to 1.7 lb. of fuel per b.h.p. per hour during a week's work of 55 hours. If the boilers are to be fired by producer gas, for which purpose slack and dust can be used, then each b. h.p. will require about 2 lb. to 2.2 lb. of coal. Internally-fired gas and oil engines are approximately twice as efficient as steam engines, which means that they utilize about 25 per cent. of the available heat.

Crude oil being 37 per cent. better than good ordinary coal, oil engines should use only about three-eighths of the quantities of coal mentioned above, say about 0.6 lb. per B.h.p. Then, however, as there are no boiler radiation losses over night, a material saving results, and the oil consumption per week of 55 hours may be about 0.5 lb. per B. h.p. Petrol and similar internal-combustion engines would require about 0.4 lb. per B.h.p. Gas engines have also about the same efficiency as oil engines; but as there is a loss of about 20 per cent. in the producers, if these work day and night, and another loss of quite 10 per cent. if they have to stand idle overnight, the efficiency of gas engines is only about 40 per cent. better than that of first-class steam engines.

Fuel Cost Relationship.

The following table shows the relationship of prices of the various fuels, each column giving those prices at which equal economy would be achieved if any of the power processes mentioned are used:—

Crude oil, per ton	$9.00	$10.00	$11.00	$12.50	$14.00	$15.00
Crude oil, per gal.	3.5c	4c	4.5c	5c	5.5c	6c
Good coal, per ton	6.50	7.50	8.50	9.50	10.25	11.25

Thus, at present, it would cost just about as much to use a Diesel engine, as a steam engine, and in remote districts the Diesel engine would probably show to advantage. Petrol engines are, of course out of the question from an economical point of view, for the present price of petrol is quite three times as high as that mentioned above. It ought to be profitable to work internal-combustion gas engines, for although gas producers can be fed with very cheap fuel, the above list shows a profit even when paying 15 per cent. more than for steam coal. The reason why these engines are not used as much as might be expected is that they are not self-contained like oil engines, but are hampered with costly and troublesome gas producers. In order to reduce this nuisance, gas might be produced at central stations and supplied through pipes to gas engines at the works; but that means that factories would have to cluster themselves together, which is against the present tendency, and way-leaves for large pipes would have to be obtained.

Diesel Engines.—It has recently been pointed out that the capital cost of a Diesel engine direct coupled to a generator is considerably greater than a gas or steam-driven generator of similar capacity, but when the costs of complete plants, comprising either gas or steam, are compared, there is but little difference in the price per kilowatt. A Diesel station, however, requires less land and buildings than similar stations employing steam or gas plant, so that the difference, if any, is probably in favor of the Diesel plant.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the operation of Refrigerating Machinery.

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Vol. VI. NOVEMBER, 1912 No. 11

A PHASE OF TECHNICAL EDUCATION.

ATTENTION has already been drawn in the editorial columns of this journal to the widespread desire towards, and inauguration of schools or institutes for the dissemination of technical education in leading cities of the Dominion of Canada, and at this particular juncture, we desre to discuss a feature of the situation which, without mincing matters, shows the utter disregard being shown in one or more instances, at least, to the most elementary considerations which nature demands should be fulfilled between a man and his fellowman. We refer to the disposition or attempt to give something for nothing.

Let us say at the outset, that we recognize not only the value, but the need of technical education in this land of possibilities, but in so doing, and with all due respect to the sincerity of purpose, if it exist, of the active agents in the movement, that we are heartily out of sympathy with a system which provides fat salaries, secured by Government subsidy or otherwise, to men who will lend themselves to such a proposition as the levying of nominal fees, baited with the catch-penny return of same on a mere attendance basis. We say without hesitation, and backed by experience, that anything worth having is, in the nature of things, worth paying for, and that a technical education, like everything else, cannot be secured for a trifling two hundred cents or thereby. Much money has been spent in securing data, much is being and will be spent in providing comfortable cribs for administrators, palatial buildings and elaborate equipment, but little thought and still less consideration is being given to the ultimate object or outcome of the scheme. Little if any allowance has been made for the student feature, its disabilities and moral sensibility—the ridiculous, insulting-to-moral-sensibility and "drink, puppy, drink," scale of fees being altogether ample evidence.

The acquirement of a sound technical education is a rational purchase, and should in the first instance be reckoned as such by the sellers. There should be none of the "cheap jewelry" feature, and still less of the "get-rich-quick" methods connected with its get-up. Students of the mechanical arts have just as keen a perception, and are as capable of analyzing "wildcat" schemes of acquiring knowledge as are the most discriminating in other spheres, where men barter for at least one hundred cents to the dollar. Speculation in most cases is disastrous, but even in "mines" has panned out on occasion, satisfactorily. Has speculation, we ask, and we know it has been tried, ever succeeded in the realm of education? With all respect to the enthusiasm of well paid dispensers of knowledge, let us say, that something more convincing is required to impress both the student and the onlooker, that the sacrifice of the former's time, disregarding the required financial outlay, is worth while. There is an increasingly strong desire abroad to-day to furnish a high class product in every line of manufacture, and much thought and study has been and is being given to its realization in the mechanical arts. Operators have become imbued with the spirit of the movement, and recognize in it the certainty of higher returns to themselves, corresponding to the improved methods of production. The natural line of reasoning they will take in this technical education feature of which we have been speaking, is that little, if anything, is likely to be gained. A youth or man, to-day, finds study hard and irksome, perhaps more so than in any previous epoch, and a stake of two dollars per session will not tend to relieve the difficulties, neither will it make him mourn much, should the burden of acquirement of knowledge prove too heavy to bear.

It has been urged that the "low fee and return" method admits of the opportunity being available to lads earning small salaries, who have aspirations to higher achievement, and whose very youthfulness precludes the possibility of paying more, or indeed, anything, for a considerable time in the immediate future. In such cases, while there may be some semblance of justification, it is overwhelmingly apparent that the tendency will be towards removal of much of the ambition and incentive to overcome such disabilities as that of the cost of educating one's self. Nominal fees, such as are being charged, lead to a monster enrollment at session opening. Unfortunately, however, these have never been of even statistical value, much less creditable for a reasonable percentage of individual achievement.

All experience in technical education work goes to show that enrollment by hundreds in all or any subject means at a period long before vacation is reached, reduction to a mere handful. Further, technical schools, no matter how magnificently equipped, and efficiently staffed make no pretence of catering to the abnormal rush to become members of the more familiar mechanical classes. Were they to do so, there is a probability that more "wheat" would be garnered, but it is doubtful if the means would justify the end. Large classes minimize the chances of individual instruction, and most students need the latter to the fullest extent possible. If they don't get it they naturally quit, and more or less discontent, accompanied by unkind but deserved criticism, follows. Instances are on record where, in spite of reasonably high fees, it became necessary, on account of the huge enrollment taxing the college capacity, to double-up the fees, and whether it was complimentary to the value of the instruction being given, or for some other reason, the enrollment suffered little in consequence.

GAS AND OIL ENGINE PROGRESS

A record of principles of design, construction and achievement in a rapidly developing sphere of power generation.

NEW TYPE OF GAS ENGINE.

A PAPER on a new type and method of construction of large gas-engines was contributed at the recent meetings of the Iron and Steel Institute in England, by Mr. Alan E. L. Chorlton, of Messrs. Mather and Platt, Limited. It is understood that three of these engines are running day and night at works in the Manchester district, and that another, after exacting trials in the Mather and Platt shops, is being erected at a colliery. It is proposed to manufacture them in powers up to 4,000 b.h.p., or greater if occasion arises. They will be designed to run at fairly high speeds, and thus will be applicable to purposes for which vertical steam engines are now used.

Gas-Engine Progress Limitations.

Mr. Chorlton said that the limitations which had prevented the progress of the large gas-engine were primarily due to: (a) The prevalence of the belief of unreliability, and (b) the comparatively high total first cost of installation. The former belief had, of course, been formed from the troubles experienced in the past, though it had been actively combated by various engineers when referred to present types. Constructionally it might be said to refer to the cracks and breakages of important parts of the engine, undoubtedly a too common occurrence in the past. Generally, these troubles sprang from initial foundry strains set up between the inner and outer walls of the casting when these were cast in one piece, as was the original practice. These initial strains, augmented by those set up through the different temperatures of the parts when working, eventually caused cracks and failures. Makers were accordingly compelled first to discover the reason, then amend their designs to prevent them. The final forms of all types had the inner and outer skins of metal connected only as far as possible in one place, the other ends being left free to allow all the differential expansion and contraction set up in the foundry and in working to take place freely.

Unreliability of Valves and Valve Gears.

The next source of unreliability was in the valves and valve gears subject to the heat and stress of the explosion. Obviously, an improved engine should, if possible, be valveless, have cylinders of simple pipe form, and have separate jackets. The only large engine with cylinders of pipe form without valve pockets, etc., in which the two pistons performed the various valve functions successfully, was the Oechelhäuser. The disadvantages of this type (horizontal), which had restricted its use, although its thermal economy was well known, sprang from other causes, such as high first cost and large floor area covered. The success of a valveless action was confirmed by the author's English experience with the working of the central exhaust ports by the piston in the Korting type engine —an experience which clearly indicated that there was no apparent reason why the air and gas inlet to the cylinder should not be controlled by a similar method in an adjacent cylinder.

Improvements in Design.

The outcome of this was the adoption of two parallel cylinders with ports about the middle, connected by specially shaped passages at their ends; one piston thus controlling the inlet through the ports in one cylinder, and its fellow expelling the exhaust through a similar set of ports in the other cylinder. This design was more or less bound to be of the two-cycle type. The cylinder consisted of two single-walled U tubes placed end to end, the inlet and exhaust ports being about the joint, while flanges on the cylinders—set back somewhat from this juncture—held, in between them, the exhaust and inlet boxes. The whole cylinder unit presented extremely simple forms of single-walled castings, particularly suitable for successful and economical foundry work without setting up casting or expansion strains, and also for use in internal combustion work itself, as there were no pockets or irregular shapes; all the sections were more or less cylindrical, including the connecting passages, and no heavy flanges or joints occurred about the points of maximum pressures and temperatures as in the ordinary type of engine.

This form gave most effective cooling to all parts, as being inherently of a strong section they could be made with comparatively thin walls. The efficiency of the cooling was further increased by the accessibility of the water to all parts of the combustion chamber, the usual thick flanges and joints there being avoided. Thus, the engine might run at a higher temperature than was usual in the present large sizes. The absence of joints and cavities in the combustion chamber reduced the risks of pre-ignition, and improved the efficiency of scavenging. High compression could be used without the disadvantages of water injection.

All the cylinder, etc., walls being single, the jacket must be provided in a suitable manner to retain the necessary water, and this was most readily done by dropping the whole duplex cylinder into a simple tank, the cylinders resting by their central flanges on stools on the tank bottom or engine entablature. By this construction was secured at once complete allowance for temperature expansion without restraint; the exhaust outlet, the only connection to the outside, passed through the tank wall by a stuffing box, or a flexible membrane was used, the connection to the charging pumps being within the jacket tank. It would further be seen from this design, that in casting complete expansion was allowed in all directions, and no strains were set up, all the cylinders, etc., being single walled. Difficulties with valves were done away with, for though these were now much rarer than in the past, still the exhaust valve of all four-cycle engines remained a part requiring considerable attention. No doubt the present large horizontal gas-engines with their simplified valve gear were a great improvement over the previous types; still the further great advantage of an engine with no valve gear must be apparent, particularly when taken into account with the possibilities of higher rotational speed.

First Cost.

For large powers, the present comparatively slow-speed horizontal engine was the only one in the field, and the large amount of room taken up by this type, with its expensive foundations, etc., was well known. The cheaper prospect, judging from steam usage, and some work already done in medium-powered gas-engines, lay in the vertical design. Again, judging from steam practice, a high-speed forced lubrication closed-in type, particularly for electrical work, was the most successful; incidentally the oil from the same system might be used for piston cooling as was now standard practice in Diesel engines. It seemed necessary, therefore, that the engine should be vertical high-speed enclosed with forced lubrication, for in that way flywheels were greatly reduced in size, weight and price; generators were less by about 50 per cent.; foundations being a simple block were cheaper by a like ratio; buildings, owing to the small floor space taken up were greatly decreased in size; the crane was of less span, and probably had to lift a much less maximum weight.

As the vertical duplex type ran at twice the speed of the present horizontal, and if the cost of the engine itself was not taken at a lower rate, although it seemed reasonable to suppose that it might be, a comparative table of costs per b.h.p. might be given as follows:

	Horizontal.	Duplex.
Engine	$25.00	$25.00
Flywheel	2.50	1.00
Generators	10.00	5.00
Foundations	1.75	.87
Buildings, Crane	5.00	3.37
Totals	$44.25	$35.24

These figures were comparative only, and might be taken on a lower basis. The reduction in cost, however, effected by installing the large vertical duplex type as against the present horizontal engine was 20 per cent. If the engine was taken at $22.50 per b.h.p. the gain was 26 per cent.

Summary.

A brief general description of the improved type of gas-engine derived from the foregoing would be as follows: The engine was of the vertical type, very similar in a general way to those steam-engines now so much in favor in this country. It worked on the two-stroke cycle. All working parts were enclosed, and the lubrication was by oil under pressure from a direct coupled rotary pump. The engine might thus run at considerably increased rotational speed, and from the fact that there was a compression on each stroke of the two-cycle engine balancing the inertia of the reciprocating parts, a higher piston speed than was usual can thus be adopted with the attendant thermo-dynamic gain. The cylinders were of the duplex valveless type, supported about their centres and free to follow the various temperature expansions in every direction. The necessary water cooling jacket was provided by the cylinder being placed within an ordinary cast-iron tank, and where the exhaust branch passed through the tank side a flexible connection was provided.

Ordinary air and gas charging pumps driven by an auxiliary eccentric were provided at one end, within or alongside the tank, and connected direct to the inlet valve box of one cylinder. The duplex power cylinder was so arranged that the exhaust piston had a lead over the inlet piston. The governor was gear driven, and acted on a simple control valve on the pumps. The ignition was of the rotary magnetic high-tension type in duplicate. Other details of the construction were similar to standard high-speed steam-engine practice.

Vertical Twin Duplex Engine.

The cylinder dimensions of a vertical twin duplex engine of 6,000 b.h.p. were 36 in. diameter by 43 in. stroke, and the speed was 140 r.p.m. The flywheel was 12 ft. 3 in. diameter and 60 tons in weight, and the floor space taken up by the engine was 475 sq. ft. The author saw no reason why cylinders of 48 in. diameter should not be successfully used, and it was interesting to note that a triple duplex, with 48 in. diameter cylinders and 4 ft. stroke, running at 125 r.p.m., would give about 16,000 b.h.p. at a moderate mean pressure.

Test Data.

A standard high-speed engine of the vertical duplex type, upon which very exhaustive tests had been made on the shop test plate, gave the following figures: Mechanical efficiency, 85 per cent.; heat consumption per b.h.p., 10,500 B.t.u.; water consumption per b.h.p., 4 gallons; oil consumption per b.h.p., 0.0004 gallon; governing, 1½ per cent. rise full load on and off—steady afterwards. These results were from cylinders 15½ in. diameter by 18 in. stroke, and would doubtless be improved upon with larger cylinders and further refinements.

STEAM AND OIL ENGINE COSTS.

SOME comparisons are made by Mr. J. A. Walker, chairman of the Nitrate Producers' Steamship Co., Ltd., between the cost and running expenses of oil and steam-engined vessels. If an oil-engined ship is compared with a steamer of the same size, other conditions applying equally to both, a margin of superiority must be conceded to the oiler. Fuel is carried in her double bottom, thus reducing the space occupied by coal in a steamer, thereby increasing the accommodation for cargo. Her power is developed on .4 lb. of oil per i.h.p. per hour, which is usually contrasted with a triple-expansion engine alleged to consume 1.6 lb. of coal per i.h.p. per hour: thus a margin of 1 to 4 is shown in favor of the Diesel. The fact that .4 lb. oil produces the same energy as 1.6 lb. coal is only immaterial if the price of oil is less than four times that of coal.

British shipowners should risk running steamers too long rather than the reverse. If steamers can compete to-day, there is little to fear, as the ingenuity of marine engineers is not nearly exhausted. Coal consumption continues steadily to diminish, and as reliable metals now exist to control higher pressures, the five-crank engine may supersede the quadruple, while the geared turbine has great possibilities, from both of which will issue greater economy still. Considerable developments also underlie artificial methods of increasing the calorific power of coal, in which is included the use of some oil fuel.

To-day, quadruple engines do not use 1.6 lb. of coal per i.h.p. per hour. With superheated steam only about 1.2 is used, which, compared with the oil engine at .4 lb., is as 3 to 1. Unless, therefore, the oil-engined ship gets her oil at about $7.25 per ton, this gives the steamer an actual trading advantage. Added to this, it must be considered that the freight alone to-day on oil from America to the Black Sea is over $10.00 per ton, and it is held in fewer hands than coal, consequently the market is more sensitive to manipulation.

DIESEL ENGINE AUXILIARY STATION, OSHAWA, ONTARIO.

THE Electric Power Company will install at Oshawa, Ont., an oil engine plant, as auxiliary and standby for their high tension transmission system. The first installation will consist of one 650 h.p. Diesel oil engine, direct connected to a 500 kv.a., 3 phase, 60 cycle, 180 r.p.m., 4160 volt generator. The engine and generator are being furnished and will be installed respectively by Messrs. Willans & Robinson, of Rugby, England, and Messrs. Kilmer, Pullen & Burnham, of Toronto. The building being erected is designed for two units, but is arranged so that it may be easily extended to house four additional units similar to the above. The plant is arranged for standby service for the Oshawa Electric Light Co., and also to feed into the Seymour Power & Electric Co.'s 44000 volt transmission system through the step-down sub-station at Oshawa. Messrs. Smith, Kerry & Chace, of Toronto, are supervising the work.

FILTERS AND GREASE EXTRACTORS.

THE greater majority of power and manufacturing plants use water which contains finely divided particles of clay, sand and organic matter in mechanical suspension and some chemically combined elements, all of which are detrimental to the equipment. The chemically combined elements can be precipitated by treatment in tanks, or in combined heaters and purifiers. These precipitates, however, will not be entirely eliminated unless the water so treated is allowed to remain stationary for a great length of time. Sand and the other weighty particles of sediment will fall to the bottom if the liquid remains stationary a sufficient length of time.

The installation of a system of settling tanks would therefore eliminate the sands and other sediment, but this method requires valuable space and is expensive. The finely divided particles of clay and organic matter would, however, remain in mechanical suspension, and if allowed to enter the boilers, they would bake on the surfaces, forming scale and decreasing the efficiency, or corrode the surfaces with which they come in contact. If these impurities are not removed from water, the quality of the products will be greatly impaired, resulting in commercial loss. It is decidedly important to remove all substances held in mechanical suspension.

In addition to the impurities originally contained in water, oil and grease are added to the feed-water supply by condensing engines, or by improperly equipped heaters, and it is a well-known fact that a greasy substance in contact with the heating surface of a boiler greatly reduces the amount of heat transmitted per square foot of heating surface. Oil and grease are also liable to cause the shell or tubes to sag and rupture, due to overheating, thereby resulting in serious accidents.

Elliott Filter Data.

Elliott filters and grease extractors are made in two types—the single and the twin.

The single filter consists of a filtering chamber containing the filtering media, and a base which is divided to direct the flow through the filtering chamber, or by-pass when cleaning. Valves are provided at either end of the base to put the filter in or out of service. The filtering media is Terry cloth, double thickness, supported by spacers and spreaders around a central column. By this method of support, practically the entire exposed area of the filtering media is available as effective filtering area.

The single filter is suitable for general service and applicable to the majority of conditions, where the filtration of a liquid is beneficial. Owing to the fact that the liquid must be by-passed for several minutes while the filter is being cleaned, the best results would not be obtainable from this type if the quantity of impurities was excessive, or constant and continuous filtration was demanded.

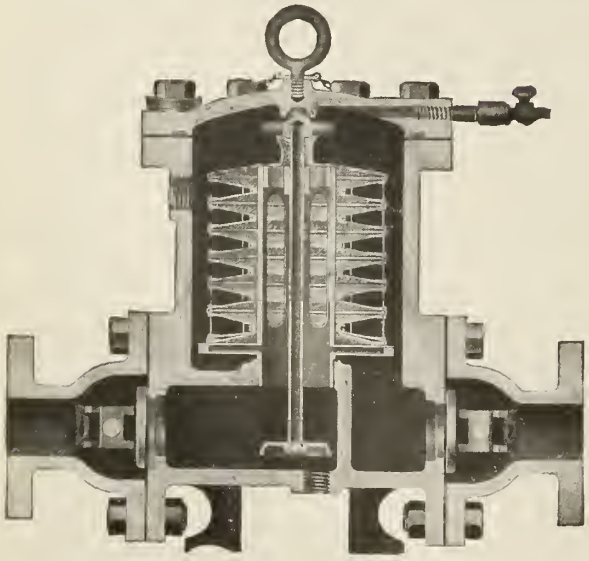
The twin filter, as its name implies, consists of two filtering chambers having a common base. Otherwise its construction is similar to the single filter, except the elimination of the by-pass, which is unnecessary. The twin filter is suited to all conditions of filtration service, more especially those conditions where a constant and continuous supply of filtered liquid is necessary. Having two filtered chambers, one of the filters is in constant service. It is particularly well suited for Central Station service, or service where the normal capacity of the plant is exceeded for periods of operation. The operation of these filters is described as follows:

Referring to the cross section, the liquid to be filtered enters at the left from the pumps, passes up and out through the central slotted column, coming in contact with the filtering media, consisting of two thicknesses of linen Terry mounted on spreaders and spacers. This media removes the impurities, the filtered liquid passing into the surrounding chamber, down and out at right into the line to closed heater, boilers or where desired.

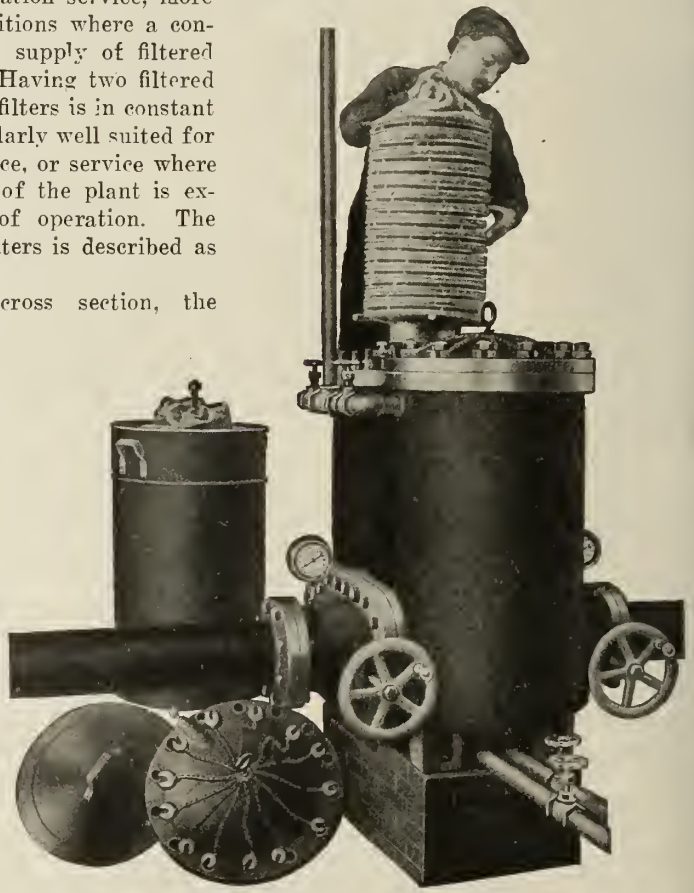
Owing to the entire elimination of perforated metals in contact with the filtering media, the water passes through the filtering material with very little friction. The continued use of the filter will result in foreign substances accumulating on the surface of the filtering material and increased resistance. This resistance is at all times shown by the pressure gauge, connected on both sides of the filtering material, and a pre-determined difference will indicate the necessity of cleaning.

The Elliott filter can be cleaned easily. The entire interior, consisting of column, its valve and filtering material, is removed in a single operation. To clean, the flow is directed from the filtering chamber containing the fouled media by shifting the valve at either end. By admitting water from the feed line through the connection provided in the filtering chamber, the direction of flow is reversed.

Elliott & Co., Pittsburg, Pa., are the makers of this apparatus.



ELLIOTT FILTER IN SECTION.



ELLIOTT SINGLE FILTER AND GREASE EXTRACTOR.

OIL ENGINES FOR LAND AND MARINE PURPOSES.

THERE is a host of different 4-cycle makes of engines too numerous to mention. In many main features, all these engines are more or less alike, but in the smaller but not less important details, such as valves, vaporizers and ignition devices, each maker has ideas of his own. The construction generally of the smaller sizes of the horizontal type is akin to the 4-cycle gas engine, and also the methods of operating the valves, the principal differences being, of course, in the vaporizers and ignition devices. Now, the 2-cycle engine is quite different. It is usually of the vertical type, can be made valveless, and has the other advantages previously mentioned as to weight and space, and no need for highly-skilled attention.

The Bolinders Engine.

I will give a brief description of the operation of Bolinders crude oil, valveless, 2-cycle engine. On the upstroke of the piston, the charge is compressed, while air is drawn into the crank case through two automatic flap valves. As the piston comes to the top of its stroke, fuel is injected into the hot bulb and immediately converted into vapor, and, mixing with the compressed air in the cylinder, is fired. While the piston is then moving down on its working stroke, the air in the crank chamber is compressed to about 15 lbs. to 20 lbs. The piston, now nearing the end of its working stroke, uncovers the exhaust port, and almost immediately after, the air inlet port from the crank chamber is uncovered, admitting the compressed air from the crank chamber. The head of the piston is so shaped that the air first rushes to the head of the cylinder, completely scavenging it, and then, as the piston moves upward again, the two ports are closed, and the remaining charge in the cylinder is compressed. An ordinary blow-lamp is used for the preliminary heating of the hot bulb, which takes 10 to 15 minutes, and the governing is done by varying the supply of oil to each cylinder. These engines are made in sizes from 3 H.P. to about 320 H.P., the horsepower per cylinder being 80. The fuel consumption ranges from .54 lb. per horsepower per hour in the smaller sizes to .48 lb. in the larger, which is quite a small increase over the Diesel engine.

Oil Engines for Marine Purposes.

The position of the oil engine for marine purposes is now such that every shipowner must be more or less considering the question of its adoption, the results of previous achievements and the number of ships and boats already fitted out having demonstrated its value sufficiently to remove much of the prejudice that may have previously existed, and we have now reached a stage in the history of the marine oil engine when progress will be very much more rapid. The reasons that are bringing about present changes in marine work are due to the way manufacturers have adapted their engines to suit the particular purpose and the enormous increase in their horsepower, and also to the necessity now realized, in times of keen competition, of economizing in weight, space, labor, and fuel costs. Apart, however, from the question of economies, there are two points essential for a successful marine engine, the one being reliability with which one can combine simplicity, as they usually run hand in hand, and the other the question of starting and stopping and, perhaps of even more importance, the reversing. These are the points which in the past made progress slow.

Reversing.

There are now in use three distinct methods of reversing: (1) The use of clutches and gears in small boats. (2) Reversing the engine by compressed air. (3) Direct reversing of the engine by prematurely igniting the charge on the upstroke of the piston for sizes up to 320 H.P. The first two of these methods speak for themselves and the time taken in reversing will satisfy all requirements, but the third system of direct reversing has been adopted, I believe, by J. & C. G. Bolinders alone. At the time of reversing, the engine is always declutched and the speed reduced to about 10 per cent. There is no sign of shock or strain, nor has the cylinder or other parts of the engine any extra weight, and the momentum to be overcome on the reversal taking place is only that of a small flywheel, which is small in comparison with a propeller immersed in water. The time taken in reversing is less than with any other engine, and although 65 of these marine engines are in use in this country, no accident through reversing has so far been recorded.

General.

All types of engines have at one time or other been tried for marine work, with varying results, but if we keep before us the two vital considerations of reliability and weight, then we may at any rate agree that the 2-cycle engine is the one to be adopted, and at present I should favor the Diesel type for the larger work, and valveless hot bulb type for the smaller. It is generally admitted that the Diesel engine requires highly skilled attention, and on a large boat carrying a staff of engineers there is no reason why it should not be, but on the smaller boats matters are very different, and the simplicity of an engine is here of considerable advantage and outweighs the additional 5 to 10 per cent. gained in the fuel consumption of the Diesel, even apart from probably smaller costs in repairs.

At present engines have been built, and are now being built, up to 7,200 H.P. in six cylinders, and makers are willing to accept orders up to 9,000 H.P. This means that it is only the really abnormal ships that for the moment are beyond the reach of the oil engine, and although the usual practice is to use two main engines, there is no real reason why a third or even a fourth should not be installed, which would result in 36,000 H.P. being put into a ship, driving the screws direct. In the case of three engines, the third would stand of course between the other two, just as if it was a single-engined ship, and in addition to increasing the reliability might on occasion be used alone with advantage, particularly when in dock.

Owing to the fact that it is only quite recently that ocean-going ships have been fitted with oil engines, it is most difficult or practically impossible to get accurate figures as to the savings in weight and space that have been effected, but to put it at a safe figure, I should say that the saving in weight should amount to 50 per cent., and in space to 45 per cent., the space alone required for the storage of fuel for equal power being one-third that of coal. What we want for this purpose is an instance of a steam engine being replaced by an oil engine of equal power, but unfortunately no such instance exists, though the ship "Uto" is a good illustration of the economies to be effected. This ship originally had a steam engine of 70 H.P., which was replaced by a Sulzer-Diesel engine of 150 H.P., and, in spite of this large increase in horse power, the weight of the complete installation was reduced from 14½ tons to 9½ tons, the necessary length of engine-room from 23 ft. to 18½ ft., and the cost run per kilometre, one-third less.

Comparative Fuel Consumption.

As an instance of comparative fuel consumption, I would quote a test made in two heavily-powered fishing boats during two months of this year, which resulted in a fuel cost of $400 for the steam boat and $180 for the oil boat, in which was a Bolinder engine. The latest example of a Diesel-engined ship is the "Eavestone," of 4,350 tons displacement. The engines are of the Carel-Diesel type and of 800 B.H.P. at 115 revolutions per minute, there being four cylinders 20 in. diameter with a 36 in. stroke. The fuel consumption on the maiden voyage with the two engines working at 650 B.H.P. was .425 lb. per brake horse power hour per hou

THE READERS' POINT OF VIEW

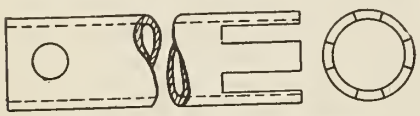
Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

EXTRACTING BROKEN TAPS.

By J. E. Noble.

IT is often a very difficult job to remove a tap that has broken off short in a hole. All kinds of schemes have been tried, with varying success, for accomplishing it, and at the best it is a slow and disagreeable piece of work.

The device herewith illustrated has been tried with good results. A suitable piece of wrought iron pipe has one end cut into slots or tongues as shown. The



REMOVING BROKEN TAPS.

other end is drilled to take a piece of steel rod to form a handle. The slotted end is now inserted in the hole so that the tongues engage with the flutes in the tap, which is thus easily removed.

SELF-STARTER FOR AUTOMOBILE AND MOTOR BOAT ENGINES.

by W. M. Brown.

THE principal features and advantages of this device are its simplicity cheapness of construction and lightness. It provides a means whereby an automobile engine can be started from the driving seat, thereby eliminating all risks inseparable from the process of "cranking up." Fig. 1 shows a cross section of the mechanism and Fig. 2. is a side view. The various parts are similarly lettered in each view.

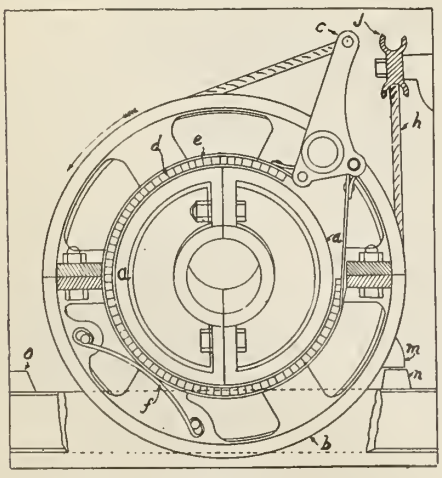


FIG. 2. SELF STARTER FOR AUTOMOBILES, ETC.

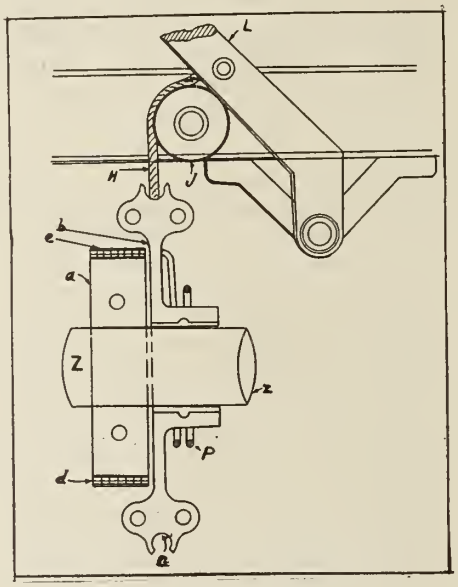


FIG. 1. SELF STARTER FOR AUTOMOBILES, ETC.

The starting lever (L) is fulcrumed to over the lever (C) by means of the cable (H), thus firmly gripping the drum (A) by the band (E) and fibre pieces (D). Circular motion is then transmitted to a side member of the frame;—see Fig. 1. Attached to it is a cable (H) which passes around the guide pulley (J) and the split pulley (B). This cable is fastened to the upper end of a lever (E). Attached to this lever at two points below the fulcrum is a steel band (E) fitted with fibre strips (D), as in a band brake. This surrounds a split drum (A) which grips the engine shaft (Z).

When the operator pulls on the starting lever (L) the first result is to pull the crankshaft of the engine by continued pressure being applied to the starting lever the whole mechanism revolving until the lever (C) strikes the knock-off block (O). This relieves the grip of the band on the drum (A), but by this time the engine will have been given sufficient compression to fire. The operator now pushes forward the starting lever to its original position, and the coil spring (P)—see Fig. 1, returns the pulley (B) back to its starting position with the stop block (M) resting on the rubber cushion (N). The spring (F) holds the fibre strips clear of the drum (A) when the engine is running.

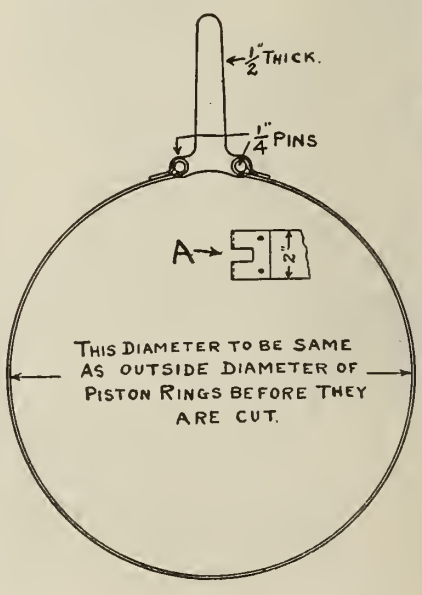
This self-starter is patented by Charles Hickling, Collingwood, Ont.

INSERTING PISTON AND RINGS INTO CYLINDER.

By T. R.

WITH the tool here shown it is possible to insert a piston and its rings without loss of temper and danger of pinched fingers. When, as is frequently the case, the tang of a file is used to pinch the rings into place, there is great risk of its slipping out, causing loss of valuable time and perhaps injuring the fitter and helper who have the job on hand.

To make the tool here shown procure a piece of spring steel, 2 inches wide by about 1-16 inch thick, and of a length to suit the diameter of the rings to be inserted. Bend the ends over ¼ inch pins as shown, and put rivets through the lap. Next remove the pins and cut slots ½ inch wide as shown at (A). These slots take the handle which is



INSERTING PISTON AND RINGS INTO CYLINDER.

forged to the shape shown and is ½ inch thick. Two holes are drilled in it for the ¼ inch pins and the latter are slipped through spring and handle.

The clamp is slipped over the piston rings which are compressed into their grooves in the piston by moving the handle to the right or left. The piston is then easily inserted, the cylinder simply pushing the clamp off the rings as the latter enter.

INCREASED LOCOMOTIVE EFFICIENCY FROM CHEMICALLY TREATED WATER.

THE Committee Report of the Traveling Engineers' Association states that the use of soda ash in the tank in the proportion of about 1 pound per 1,000 gallons, the use of caustic soda in smaller proportions, and also the water-treating plants, have all met with success so far as scale formation is concerned. In connection with the graphite, luminator and crude oil treatments, the committee has no information of any beneficial results having been obtained.

One complete report was submitted in reply to the request for the cost of treating feed-water. This was from the Santa Fe. The accompanying table gives the average costs for the different divisions:

COST OF TREATING WATER ON THE SANTA FE.

Station—	Grains of Incrustants. Before Treat.	After Treat.	Lbs. Incrustants Removed Per 1,000 Gals. Removed.	Cost Per 1,000 Gals.	Total lbs. Incrustants Removed.
Illinois Division	20.2	3.6	25.6	3.65 .0313	972,193
Missouri Division	25.7	4.4	21.3	3.04 .0210	470,463
Kansas City Division	20.7	4.8	15.9	2.27 .0230	595,491
Eastern Division	28.4	4.0	24.4	3.48 .0282	1,073,922
Middle Division	36.9	4.3	32.6	4.65 .0444	1,100,651
Oklahoma Division	34.3	4.3	30.0	4.28 .0319	808,954
All Eastern Lines	30.8	4.2	26.6	3.80 .0298	5,021,674
Western Division	33.8	2.9	30.9	4.41 .0425	654,506
Arkansas River Division	52.4	3.6	48.8	6.97 .0553	1,596,271
Colorado Division	47.8	3.5	44.3	6.32 .0231	894,667
New Mexico Division	42.9	4.3	38.6	5.51 .0186	1,006,544
Rio Grande Division	24.3	4.1	20.2	2.88 .0311	648,573
Pan Handle Division	42.4	3.3	39.1	5.58 .0432	427,695
Plains Division	31.4	4.2	27.2	3.88 .0182	41,853
Pecos Division	39.2	3.8	35.4	5.05 .0611	956,886
All Western Lines	38.9	3.7	35.2	5.02 .0375	6,226,995
A., T. & S. F. Proper	34.9	3.9	31.0	4.42 .0336	11,248,669
Albuquerque Division	34.1	4.2	29.9	4.27 .0393	1,152,635
Arizona Division	25.0	3.2	21.8	3.11 .0257	1,271,690
Los Angeles Division	23.6	2.5	21.1	3.01 .0274	1,042,723
Valley Division	22.6	2.9	19.7	2.81 .0261	171,916
Coast Lines	26.3	3.2	23.1	3.30 .0297	3,638,944
A., T. & S. F. System:					
1911	30.6	3.5	27.1	3.87 .0324	14,887,633
1910	31.6	3.6	28.0	4.00 .0318	15,284,164
1909	35.4	3.7	31.7	4.52 .0332	13,063,320
1908	35.8	3.9	31.9	4.55 .0346	11,102,859
1907	32.6	4.3	28.3	4.03 .0355	9,579,772
1906	35.0	4.1	30.9	4.41 .0361	7,906,233

The conclusions from the answers to the questions in connection with the mileage of flues and fire-boxes before and after treatment of feed-water show that an increase in mileage of from 78 per cent. to 150 per cent. is being obtained where the water is handled in treating plants. Equally good results followed the use of anti-scale chemicals in the tenders. The following is the report of the Santa Fe on this feature:—

Santa Fe Report.

"Since the adoption of our water-treating system the mileage of fire-boxes and flues has been doubled and trebled. One of the best examples is the Los Angeles division. In the latter part of 1905, eight large Pacific type oil-burning, passenger locomotives went in service on that division, and up to December, 1907, each of these locomotives had received a new fire box, six of them had received three sets of flues, and the other two, two sets; the average mileage of all fire boxes was 66,064, the lowest 62,452, and the highest 81,608. The average mileage per set of flues during this period was 25,167. There are mountain grades on which helpers are used. The work performed by these engines is heavy fast passenger service, and a very large part of the division is 1 per cent. grade. Shortly after these engines received new fire boxes, or in the latter part of 1907 and the beginning of 1908, a number of water-treating plants were installed, and three other plants were installed in 1910, consequently some of the locomotives made considerable mileage with the second fire-box before the installation of the water-treating plants was completed. There are no serious defects in these boxes as yet, and they have up to January of this year given an average service of 168,589 miles, and are still going; the flues have given an average service of over 44,000 miles, an increase in flue mileage of 78½ per cent.

Treatment Beneficial.

"We use treated water to prevent incrustration, and give credit for the prevention of incrustration and improvement in the performance of our fire-boxes and flues to the system of treating water. We use an anti-foaming treatment to prevent foaming, both with our treated water and in territories where the water is not treated. This does the work very satisfactorily, eliminating all of the troubles due to a foaming boiler, reducing the cost of fuel and lubrication, and enabling us to handle tonnage that it would be impossible to handle otherwise. In territories where the water is not bad enough to warrant the installation of treating plants, but does give trouble with foaming, we find that anti-foaming preparations have a favorable effect in preventing incrustation as well. It is but just and fair to a water treatment that counteracts or prevents foaming, to give it credit for adding to the life of the fire-box and flues, on the theory that when it prevents foaming it keeps the water in a more dense condition, so that it absorbs more readily the heat that is passing through them, and by so doing prevents their overheating and consequent damage.

General Conclusions.

Other. conclusions. reached by the committee were that treated water increases the tendency to foam; that anti-foaming chemicals are successful; that treated water does not increase the mileage between washouts; that the efficiency of the locomotive is increased by the use of treated water, especially if used in connection with an anti-foaming treatment; that the increased foaming of waters treated for scale increases the cost of maintenance of the locomotive; that blow-off cocks should be freely applied and used, that their operation should be convenient and that the frequent use of blow-off cocks for short intervals is better than longer openings at long intervals. The committee stated that soda ash is beneficial in waters where the encrusting solids are heavy and the alkali salts light.

FEED WATER SOFTENERS.

THERE are numerous varieties of water softening plants in practical use, all differing slightly. Many of these give very satisfactory results, so far as the measuring out of the reagent is concerned. Some types are fitted with exhaust steam heaters. This is, of course, an improvement on the cold process, but the complete softening of the water does not take place until the water has been in the boiler and subjected to the full boiler temperature for some little time.

If sufficient of the reagent has been put into the water, the precipitate becomes mud; if insufficient of the reagent scale is, of course, formed. Sometimes the scale is of a very soft and clinging nature, which may cause more serious trouble than where no reagent is used at all. Scale from some waters, even when very thin indeed, gives considerable trouble, while others, perhaps the majority, have been found to form a considerable thickness of scale, without the serious risk which might have been expected.

The frequent blowing down of boilers is a very important matter, and the only safe course to adopt where steam turbines are used is to have the boiler water analysed quite frequently and the density of solids kept down so low that there is no danger of priming. Almost any boiler on the market will prime badly if the solids are allowed to reach a sufficiently high figure. Dangers from priming with a reciprocating engine are well known, but with a turbine other kinds of trouble follow. One trouble which is well worth mentioning here, is that the blades may become choked with mud, usually at a point where the pressure of the steam in the turbine is about atmospheric. When turbines are run with the boilers in a dirty condition for long periods, this matter gradually fills up all available spaces, and its presence cannot but affect the efficiency of the turbine.

No hard and fast rule for the amount of water to be blown down can be stated. Water in some districts is quite soft, and in other districts very hard. The frequency of blowing down will, of course, vary accordingly.

THE PROTECTION OF CONDENSER TUBES.

By S. A. J.

THE surface condenser is well known to be subject to the evils of pitting and corrosion, and this can hardly be wondered at when the quality of water which is sometimes used for cooling purposes is studied. Such trouble goes on in spite of the use of the best materials and such waste of the Muntz metal and similar alloy is a serious trouble in modern installations, inasmuch as it is necessary to frequently test the condenser to ascertain where the pitting is going on and to plug the defective tubes. In course of time complete re-tubing becomes urgent and so the process goes on. Specially made tubes of carefully selected composition or heavily coated tin coverings have been tried, but the expenses of such special material is a serious factor. It is, therefore, interesting to turn to an arrangement introduced by the Harris Patent Feed Water Filter, Ltd., of Newcastle-on-Tyne, for protecting surface condensers from corrosion.

The Harris Protector.

The principle underlying the method is the immersion in the circulating water of a mass of metal which is electro-positive to the material of which the tubes are composed. This mass and the tubes are then connected electrically, and in this way the corrosive action is transferred from the tubes to the electro positive mass which then becomes the protector of the former. The composition of this protective metal may be altered to suit special cases, but the material usually employed is electro positive for practically all the varying alloys of copper and zinc. It maintains its protective action until it is completely dissolved. and is not interfered with by insoluble deposits on its surface. In times past zinc has been utilized in the same way to form a protective mass, but the special metal used in this process is much superior to zinc, and unlike iron or steel, which have also been tried, the metal in dissolving does not liberate particles which when lodging in the tubes may give rise to electric couples and thus form points of local corrosion.

Arrangement of Protector Equipment.

The protective metal immersed in the circulating water is connected by a cable to the tube plate of the condenser. The tubes must, of course, themselves be in proper metallic contact with the tube plate in order to ensure their protection. This condition exists when the tubes are expanded in, but when secured by the ordinary screwed ferrules, contact cannot be relied upon and in such circumstances a flexible or compressible metallic washer or grummet is placed between the ferrule and the ordinary packing. When screwed up tightly, the necessary metallic contact is secured. Sometimes, the protective mass is placed in an independent vessel communicating with the water space of the condenser by two pipes which can be shut off at will. The advantage of this latter arrangement is that it allows the appliance to be inspected or tested while the condenser is in operation. Generally, however, the protector is placed inside the water end itself, because owing to its nearness to the surface to be protected, the action is much more powerful and better able to counteract the effect of leakage and other currents which are sometimes present. Under such circumstances, it is preferable to subdivide the mass into smaller units, each of which is independently connected to a near or far tube plate. In the latter case cables are utilized which can conveniently be led through one of the tubes. The protective blocks are often carried on studs, the exact arrangement adopted depending very much upon the design, of the particular condenser.

The cost of the protector fitted up and set to work in medium sizes is about one-fifth of the cost of renewal of a single set of tubes, and in larger sizes it is very much less. The protector requires nothing beyond a periodical inspection, together with the renewal, from time to time of the protective blocks. The life of these blocks of course depends on the nature of the circulating water and other circumstances, but they will usually last twelve months without renewal and in some cases have gone for over two years. The cost of these renewals would be at the outside about two cents per indicated horsepower per annum.

The Corrosion Feature.

The question of corrosion is a far more complicated one than is usually believed. The waters of tidal rivers and estuaries vary much in corrosive qualities, and such waters are frequently more harmful than the salt water of the open sea, although the amount of salt may be less than in sea water. This may possibly be due to the presence of effluent from chemical works, sewage disposal systems, etc. It is, however, impossible to accurately foresee the conditions under which corrosion may be set up. Cases of pitting action have been known where the circulating water is derived from a pure source, the water being apparently free from corrosive properties of any sort. Moreover, out of a fleet of sister ships seemingly identical and in the same waters, it is no uncommon thing to find one or two which require new tubes every year or oftener, while in others tubes last ten or fifteen years without apparent deterioration. On the same ship even, where pitting has taken place in say a twin engine installation, one condenser frequently suffers more severely than the other. One condenser may be practically immune from corrosion, while the second may use some 50 or more tubes to the other's one.

As far as a most exacting examination can determine, the physical condition of each has been found to be identical, each engine room having its own electric installation and the position and connections facsimiles of one another. Not only is trouble found on marine installations, but it is very frequent in power stations which draw their circulating water from tidal rivers or estuaries. Where stray electric currents are met with, cases have been known where the life of the condenser tubes does not exceed from three to six months. Tramway systems, with an earthed return, offer conditions as regards leakage currents, which, unless a very efficient earthing system is adopted, may easily provide opportunity for trouble of this nature, and it is therefore a matter of paramount importance to all engineers that an efficient means of protection should be obtained.

PROGRESS IN NEW EQUIPMENT

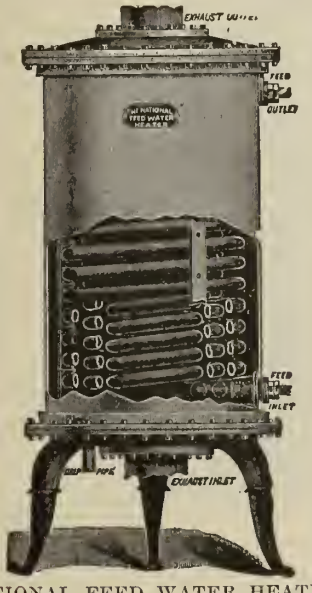
There is here provided in compact form a monthly compendium of the power plant manufacturers' achievements.

THE NATIONAL FEED WATER HEATERS.

THE advantage of heating feed water by utilizing exhaust steam needs no discussion among engineers. All recognize the saving in fuel and the benefits to the boiler. Besides, these matters are thoroughly discussed elsewhere in these columns. The only question that may possibly arise is:—shall we use a closed heater or an open heater?

Closed or Open Heater Question.

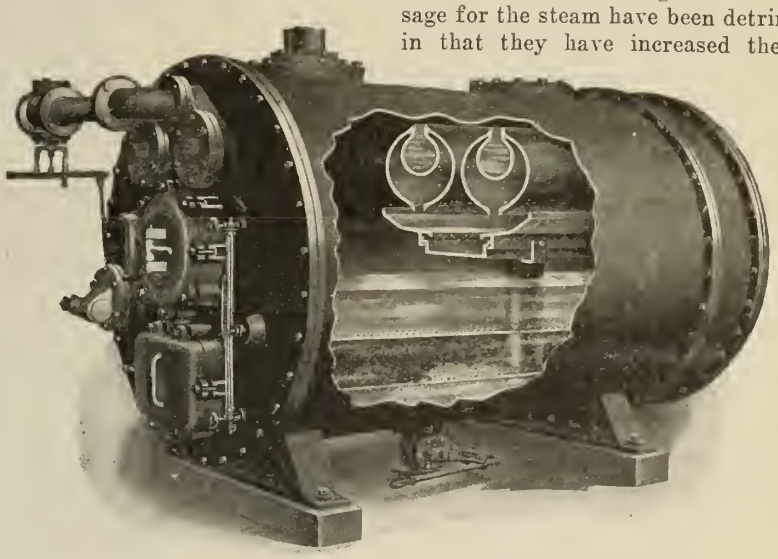
Experienced engineers recognize the fact that the closed type is to be preferred when the water is comparatively pure, that is—free from scale-forming substances and such gases as air and carbonic acid gas which cause corrosion when liberated within the boiler itself. The closed heater needs no oil separator because the exhaust steam is kept from coming in contact with the hot water. Heating is accomplished by transmission through the coils or pipes. The open heater, on the other hand, should always be selected for impure water. It provides for the removal of scale-forming ingredients, and therefore acts as a



NATIONAL FEED WATER HEATER.

purifier. It heats by direct contact, giving high efficiency, and as the above-mentioned gases in the feed water are driven off by the heat and mingled with the steam, they never reach the boiler.

The National Pipe Bending Company, of New Haven, Conn., among the oldest makers of feed-water heaters in the United States, makes both types. Their closed heater, well known among all engineers, has been thoroughly tested out by operation in all sorts of power plants,



NATIONAL FEED WATER HEATER.

electric stations, etc., to the extent that at the present time more than three and a quarter millions of horse power are installed. The heater, which is made in a full line of sizes to meet all power plant conditions, consists of a coil or coils of seamless drawn brass or copper pipe in a cast-iron or boiler-plate shell; provision being made to admit the cold feed water at one end of the coil and take it from the other end of the coil from which it proceeds to the boiler. The water is always inside the coil, never comes in contact with the iron shell, and, therefore, the shell is not subject to corrosion. The feed water itself has no action on the brass or copper tubing. The exhaust steam from the engine is admitted to the shell and although it completely surrounds the coil it moves with such velocity as to make the transmission of high efficiency.

Closed Heater in Condensing Plants.

While the National closed heater is most often used in non-condensing installations, it is a source of great economy in condensing steam plants. The reasons for this are perhaps not too well understood among manufacturers and users of condensing steam plants for the idea has gone abroad that a heater should not be used in the latter plant. This is probably due to the fact that some forms of heater having restricted passage for the steam have been detrimental in that they have increased the back pressure, or in other words, reduced the vacuum. This idea, it is claimed, does not apply to the National for the pasage of the steam is very large and in no way hinders the flow. It may even be said that the heater placed as it is between the engine cylinder and the condenser, itself acts as a condenser, due to the fact that the tubing is filled with cold water. In this way it is of assistance to the condenser, increasing the vacuum.

The advantage of using the heater in such a plant may be readily seen from the simple statement that with a vacuum of 26 inches, a temperature of 125 degs. in the feed water may be easily obtained. This means that usually there will be a saving of at least six per cent. over feeding cold water. If the idea be carried still further, and an independent air pump be used, and the feed water from the first heater pass through a second heater, it can easily be raised to more than 200 degs., a result which is practically identical with that obtained in non-condensing plants.

National Direct-Contact Heater.

The National direct-contact feed water heater needs more introduction. In fact, it is new. Although called the "direct-contact" heater, it is, in all respects of the open type. It is cylindrical as shown in the accompanying illustration, and has an oil separator forming the head at the end where the steam enters. The steam passing through this separator is entirely freed of oil and so may be mixed with the feed water. After passing through the oil separator, the steam enters and fills the steam pipe which nearly surrounds the feed-water pipe, and has an exit only in a small port at the bottom. This form of pipe also provides, in the same casting, for the water which is in a smaller or inner pipe entering at the opposite end from the oil separator. The entering cold water is tempered or partially heated by the surrounding steam, the coldest water and the hottest steam being brought together. This preheated water then overflows through the port at the top of the water pipe and flows as a thin film around the steam pipe. At the same time the steam leaving at the bottom of the larger pipe must pass through this curtain of water and coming into direct and intimate contact heats it to a high temperature. In fact, the two sheets of fine spray are heated to the highest possible temperature in the shortest possible time. The counter-current principle is adopted in this heater so that the hottest water and the hottest steam will be together at the exit end. In this manner, all the steam and all the water come in contact, and the water, when it leaves is nearly at the boiling point.

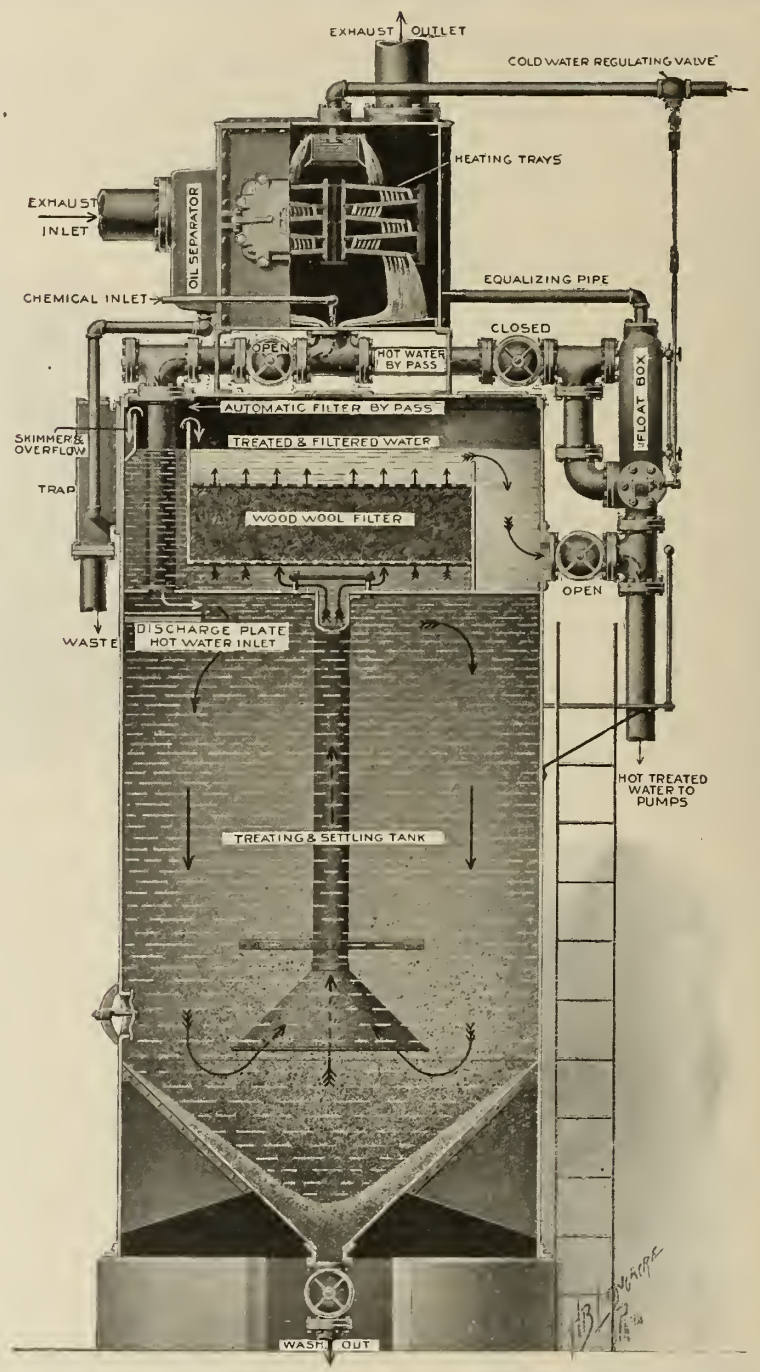
Purifier Feature.

The National direct-contact heater is also a purifier; it filters the water. After becoming heated by mixing with the steam, the water is carried by means of suitable pans and vertical pipes to a large sediment chamber at the bottom of the heater where opportunity is given for the heavier impurities to settle. The water then passes upwards through the filter bed in which are retained such impurities as may be separated by the heat of the exhaust steam; those impurities which would not precipitate in the sediment chamber. The filter bed is thereby relieved of unnecessary work, and must intercept only a minimum of the impurities, making cleaning and renewal of filter material necessary only at rare intervals. The arrangement is advantageous, in that, should the filter bed become clogged, the hot water is automatically fed direct to the pump, and should the perforated plates which support the filter bed break down, allowing the material to fall to the bottom, it would be impossible for the filter bed material to be carried over to the pump as would be the case with downward filtration.

Among other advantages of this new type of heater may be mentioned the trough which extends the full width of the heater and cast on the inside of the back head just above the water line to serve as a skimmer for surface blow off and for overflow to the sewer. It is connected to automatically drain to the sewer. This heater is readily accessible for cleaning and examination without disturbing the pipe connections. The shells which are cylindrical in form and cast in one piece are of abundant strength, with a minimum of weight, and all joints are machined iron-to-iron, making permanent joints.

THE SORGES-COCHRANE WATER SOFTENING SYSTEMS.

FOR many years the Sorges-Cochrane hot process system of water softening has been largely adopted by power plant users throughout Canada and the United States. The idea of chemically treating hot water at the boiling point has appealed, not only to chemists, but also to the operating engineers, since, owing to the fact that with this system only one chemical is required, the operation



THE SORGES—COCHRANE VERTICAL WATER SOFTENING APPARATUS.

is an extremely simple one. The temporary hardness is removed by heat instead of lime as in the Cold Process System, and the permanent hardness is precipitated by soda ash, a cheap chemical, costing in most localities less than a cent and a half per pound. In the Cold Process System much larger and more expensive tanks, in which provision must be made for from one to three hours storage, are required.

A recent development for plants with only limited space is the Sorges-Cochrane Vertical System, a sectional view of which is shown in the illustration. As will be seen, the water enters the top and is first allowed to flow over the trays in contact with exhaust steam as in a standard Cochrane Heater, thus breaking up the bicarbonates and driving off the air and carbonic acid gas which would otherwise possibly cause corrosion in the boiler. The hot water is then mixed with the chemical and conducted to the lower tank, where reaction and sedimentation take place, after which it passes up through the filter, and the clear softened water is discharged to the boiler feed pumps. In this system a special quality of excelsior or woodwool is used as the filtering medium.

Although the Hot Process method has only been developed within the past twenty years, its marked convenience and simplicity of operation have found for it a warm place in the hearts of power plant operators wherever installed. The Canadian Pacific Railway is just now installing a Sorges-Cochrane System in their power plant at Banff, Alberta, and many other owners are awakening to the fact that the prevention of all scale in their boilers means money in their pockets.

The Canada Foundry Co. Limited, Toronto, handles this apparatus exclusively in Canada.

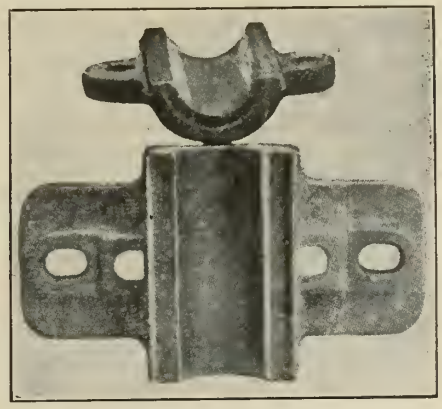
A NEW ANTI-FRICTION MATERIAL.

THERE has recently been placed on the market a new graphite anti-friction material which has distinctly interesting features. It has been given the trade name of "Graphitol," and is the invention of Mr. F. C. Wrinkler, manager of the British Pacific Supply Co., Victoria, B.C. Graphitol embodies the cement principle applied to the production of a lubricating material of a non-metallic nature to be used in place of metal babbitts and is a radical departure from previous practice both in the nature of the material and the method of applying it. It is made in the form of a fine, dry powder, which when required for use, is mixed with a prepared liquid into a stiff paste, and, without the application of heat, is put into place in the bearing box, formed or molded, and allowed to set, which it does in from eight to ten hours.

A bearing is thus obtained which is very largely self-lubricating, ensuring a low co-efficient of friction. Then, too, the heat-resisting qualities of graphite form another important advantage enjoyed by this material.

Other advantages claimed for Graphitol are:—(1) that it is very easy and entirely safe to handle, and can be used to advantage in places where it is difficult to pour molten babbitts; (2) as the material is almost self-lubricating, it requires much less oil or grease to run on than other forms of bearing material, and whatever lubricant is fed to it does not get away without being used, as the bearing material absorbs it; (3) the initial cost is less than with babbitts.

Graphitol may also be used as a pipe joint cement; to cure leaks in steam and water pipes, and as a filler in machinery and parts. Used as a bearing it has absolutely no tendency to crack or disintegrate, and shows surprising endurance. We are informed that some bearings have been running for twelve months with no appreciable wear.



NEW ANTI-FRICTION MATERIAL BEARING.

An interesting application of Graphitol was recently made in connection with a dynamo repair. The commutator was not a good fit upon the shaft, so it was centred by blocking and the open spaces were filled in with Graphitol in a plastic state, which was then allowed to set. In this particular instance it would have been very difficult to pour babbitt; and moreover the use of Graphitol obviated the danger of babbitt getting into the commutator and causing a short circuit of commutator pairs.

THERMOMETER IN THE ENGINE ROOM.

IN the reconstructed power station at El Paso, Texas, thermometers are being placed in the steam delivery outlets from the boilers, turbine steam supply mains, condensed steam discharge piping from the hot well, circulating water injection piping on the pump discharge side, circulating water discharge from the condensers, and the flue gas uptakes, besides the usual boiler feed instruments.

Recording thermometers are in use on the feed water mains leaving the heaters, on the turbine supply mains, flue gas discharge ducts, exhaust piping from turbines to condensers, and generator armature windings. A recording steam pressure gauge is in use at the steam main in the boiler-room, and indicating gauges are in service at the turbine throttle valves and circulating pump discharge pipes. A large variety of portable electrical instruments is in service to facilitate checking the performance of fixed instruments at the switchboard.

BREACH OF FACTORY ACT.

THE heaviest penalty so far inflicted on any person found guilty of violating the section of the factory act requiring the covering of dangerous machinery was inflicted recently by Magistrate Shaw on Edward H. Newton, superintendent of the Hastings Shingle Manufacturing Co., 1355 Powell Street, Vancouver, B.C., when he was fined $250. The charge was brought by Factory Inspector C. R. Gordon. The case was hotly contested and lasted some time. In prosecuting, Mr. Gordon stated that he intended to protect, as far as he and his assistants were able, the lives of the many workmen employed in the numerous mills and manufacturing plants in Vancouver.

The Can. British Engineering Co., Ltd., has been recently formed to carry on the business of an engineering supplies and construction corporation in the Dominion of Canada. It will establish branches in all the principal centres, at each of which stocks of standard appliances, spare parts, etc., will be carried. The intention of the company is to undertake contracts for the supply and erection of all classes of machinery, and to purchase the plant required, as far as possible from leading makers in the United Kingdom. The subscribed capital is $1,000,000, and in addition to a headquarters board of directors in England, a local board in Canada is also provided. This latter consists of Mr. W. A. Martin, managing director, of Toronto, late assistant general manager Toronto Electric Light Co.; Mr. Ernest M. Sellon, Montreal, director of Mathews, Wrightson & Co., (Canada, Ltd.); Mr. Charles Ruttan, Winnipeg, of Ruttan & Chipman, financial and commercial agents; Mr. Nichol Thompson, Vancouver (manager for Western Canada, Cammell, Laird & Co., Ltd.).

EDUCATION OF MANUAL WORKERS.

IN the course of his presidential address to the West of Scotland Iron and Steel Institute Mr. Walter Dixon referred to several points in connection with the education of manual workers. He stated that, over a somewhat extended period and a wide area, he had made inquiries among those who had collectively the control of about 200,000 men in the iron and steel and allied industries, with the following results:—

Deductions From Experience.

(1)—It was the unanimous opinion that any book-learning outside the rudiments of the "three R's" was a matter outside the requirements of the avocation of 90 to 95 per cent. of the usual manual workers. In other words, the work these men were called upon to do would be as efficiently, as successfully, and as expeditiously performed if they had no school education whatever beyond the "three R's."

(2)—Of the remaining 5 to 10 per cent., among whom were to be found the charge-men, foremen, and other leaders, most would attain to the leading positions in which they found themselves through and by their own initiative, if three-quarters of the existing aids to learnings were abolished; and the plethora of educational facilities did not raise more than about 1 or 2 per cent. from the worker to the overseer stage. There was a further widespread opinion —it might almost be called a unanimous opinion—that as regards the 90 to 95 per cent., not only would the work be done equally well and efficiently were the workmen devoid of their present so-called "education," but it would be done more expeditiously and more satisfactorily, inasmuch as there would be less unreasonable restlessness and less unreasonable discontent, the inevitable result and the danger of a universal "little knowledge," causing the men to be a constant and easy natural prey of those who had the little more, though equally inadequate, knowledge.

(3)—A further unanimous opinion was that leaders, foremen, and overseers were in an overwhelming degree born, not made, and therefore that all forced school education beyond that already indicated—at least all forced technical education—was, for the majority whose lives must be devoted to manual labor, not necessary—indeed, perhaps harmful.

The Aims of Education.

The president said that while he appreciated that many things might be said counter to or in modification of these conclusions he put them forward as indicative of the opinions of the leaders of certain industries, and his investigations into other industries far removed from that of iron and steel assured him that in the main they had the approbation of those who controlled the majority of our industries. This being so, did it not call for a review of our educational methods, and might it not be possible to put our education on lines more suited to the conditions under which we lived? If it was a fact that education, as ordinarily understood, was a thing apart and outside of the avocation of most of our workmen, should not the education be designed in the main for the benefit and purposes of their recreative hours, giving up the idea that any material benefit was to be derived from technical education other than the best of all technical education — viz., that which men received in the course of their daily work? It was widely alleged that the effect of artificial forcing upon masses of partially-developed minds was largely, if not mainly, to spoil what would otherwise be good workmen, and to manufacture a half-efficient, half-developed, and constantly discontented class of aspirants to positions of responsibility and trust for which they were entirely unfitted.

National Dependence of Industrial Workers.

He was not prepared to offer suggestions for change beyond saying that so long as the existence of any nation depended upon its industries there must be men who were prepared to do manual work, men who regarded such manual work as an honorable avocation, and not as slavery—a term which was now—largely, as he believed, owing to our educational methods—applied to many manual avocations. It must be recognized that the mechanical developments of the last half-century had done away in a large measure, and for ever, with the possibility of the interest which a man could once take in his daily work, inasmuch as few men now made anything, but only a very small portion of something. It must further, be recognized that, under the reign of industrial competition, the hours of labor were likely to be hours of stress, and that when a man had finished his labor it was only right that he should have hours of reasonable recreation.

It was with a view of making these hours of recreation worthy of the nation that he felt our educational methods might and would ultimately be altered. This time would the more quickly come when we ceased to lose sight of the fact that education so-called—either technical or otherwise—to which our educational enthusiasts of to-day would more or less exclusively devote so many of the earlier years of every man's life, was only one—and that by no means the most important—of the factors essential to every one of the men who could possibly rise above the purely manual worker. Of these other factors, an inborn common sense and natural level-headedness might be said to be the most important. While, therefore, many of the subjects — if needs be, all the subjects — which were taught in our schools at present might be continued, he thought the point of view and the object for which they were taught might be largely remodelled, and the subjects so treated that each student might in some way get that which was commensurate with his mental and relative physical status.

LARGE TESTING MACHINE.

A TESTING machine with a capacity up to 10,000,000 pounds, and reputed to be the largest in the world, has been installed in the laboratory of the Bureau of Standards at Pittsburg, Pa. The machine, according to details published in the Engineering Record, has been designed to test a 60 ft. column vertically, and it consists mainly of two large heads, each weighing approximately 30 tons, and four straining screws, 13½ in. diameter, placed upright at the corners of the machine. These screws support the upper head and enable it to be raised or lowered, to accommodate the length of column to be tested, by four nuts operated simultaneously through gearing. On the lower head are mounted the cylinder ram, and lower platen, and the pressure is applied to the ram by means of a three-plunger variable stroke pump, worked by a 15-h.p. motor, which forces oil into the cylinder.

MOTOR CARS IN CANADA.

IT is interesting to note how the well-being of Canada is shown in the common use of the motor car, and this despite the hindrances in the way of poor roads and other obstacles to locomotion. The bulk of the cars are imported, the greater number being from the United States, with a few from England. There are, however, seven or eight motor companies in Canada, two of which are native Canadian undertakings turning out a special type of car.

The popularity of the car is greater in western than in eastern Canada; and this is easily explained by the contrast between the topography of these two parts—the open prairie, with its trail and small rainfall, permitting easy travel in almost every direction. Doubtless, if the tests now being made of the motor car in Australia, which is very much on the same principle as the stump-

jump plough, and rides over rough bush roads without jolting passengers or goods, are successful, the eastern provinces of Canada will be able to make use of motor locomotion in many districts where it is now practically impossible.

INDUSTRIAL ACCIDENTS.

ACCORDING to the record of industrial accidents compiled by the Department of Labor, that for the month of September shows that 89 workmen were killed and 419 injured; a total of 508. Compared with a record for August; this is an increase of one fatal and 114 non-fatal. The trades and industries in which the greatest number of accidents occurred were: steam railway service, in which there were 28 fatal and 123 non-fatal; metal trades, with 3 killed and 72 injured; mining. with 10 killed and 42 injured; and the building trades, with 10 killed and 33 injured.

THE DE LAVAL STEAM SCALE AND DIAGRAM.

THE Mollier diagram is now generally well known to engineers as the most convenient means of determining, with all the accuracy reasonably required, the heat available from the expansion of steam from a given initial condition to a given final condition, and also for determining by comparison therewith the efficiency ratio of an engine or turbine of known steam consumption, or the quality of the steam at the end of expansion in a heat motor of which the steam consumption is known.

As the Mollier diagram is ordinarily arranged, however, its use is rendered difficult and its accuracy impaired by the fact that the total heat of the steam in the initial condition must be read off from the scale and the operation repeated for the final condition, after which the figures are subtracted one from the other and multiplied by 778 to give the available foot pounds, while to obtain other quantities involves several more tedious arithmetical operations.

All these difficulties are removed at one stroke by the use of the steam scale devised and published by the DeLaval Steam Turbine Co., of Trenton, N.J., manufacturers of single and multi-stage steam turbines for all capacities. This steam scale is a graduated measuring rule, bearing four different scales. The first, having uniform graduations, may be applied to the chart to measure directly the B.t.u. available between given initial and final conditions of the steam. A second edge of the rule bears a scale showing the resulting velocity of the steam when expended through a nozzle in feet per second, which may also, therefore, be read off at once, without computation. A third edge shows the duty in millions of foot pounds per thousand pounds of steam developed by a perfect engine working between the limits assumed, while the fourth edge gives the steam consumption in pounds per r.p. hour. Conversely, if the steam consumption of an actual engine be known, the last named scale enables the user to find the resulting quality of the steam at once from the diagram, without further measurement or computation. With this chart and scale in his possession, the engineer has the equivalent of complete steam and entropy tables, also tables for converting B.t.u. per pound of steam to jet velocity, steam consumption and duty without computation. The limits of error appear to be in general less than one per cent., and the accuracy is greater than this for some of the operations.

On the back of the chart are printed concise directions for using the scale, with an illustrative example. Copies of the scale and chart will be gladly sent by the DeLaval Steam Turbine Co., to engineers and others interested in the steam consumption of engines, turbines, etc.

JOSEPH DIXON CRUCIBLE CO.

AT the regular monthly meeting of the Board of Directors of the Joseph Dixon Crucible Company., held on October the 21st instant, the following changes in officers and board of directors were made on account of the death of Vice-president Wm. H. Corbin; George E. Long, former treasurer, was elected vice-president to succeed Mr. Corbin; J. H. Schermerhorn, former assistant secretary and assistant treasurer was elected to membership in the board of directors and treasurer; Albert Norris, assistant secretary and assistant treasurer.

A USEFUL BOOKLET.

THERE has just been issued by the **Smooth-On Manufacturing Co., Jersey City, N.J.**, the twelfth edition of the Smooth-On Instruction Book, which is well worth having. The great value of Smooth-On to the user lies in its peculiar chemical properties, namely, of metalizing and of expanding when metalizing, and it can be prepared to act quickly or slowly, according to the requirements of particular uses. These properties make Smooth-On a valuable substance in the making of chemical iron cements. To this subject the company's chemist has given careful study for eighteen years, and has succeeded in compounding the valuable iron cements known so generally throughout the world as Smooth-On iron cements. These cements are made each for a special purpose; they are carefully prepared, and when correctly used they make permanent repairs. The different Smooth-On cements are explained in the book, and a careful study of these will prove interesting and profitable. The illustrations are made from photographs of actual subjects, and show some of the many ways in which the Smooth-On cements have been used and the results obtained.

This instruction book will be sent free of charge to any reader of this journal who will send to the Smooth-On Mfg. Co. his name, address and occupation.

A SOUVENIR THERMOMETER.

The Canadian Steam Boiler Equipment Co., Ltd., 211 Queen St. E., Toronto, are distributing among their friends an attractive little thermometer mounted on an aluminum backing. It registers from 20 below to 120 above zero Fahrenheit and is remarkably sensitive. It can be conveniently hung up in office. shop or engine room and will be mailed free to anyone writing on their firm's letterhead.

The thermometer serves as a useful reminder of the merits of the well-known "Cyclone" Shaking and Dumping Grate Bar, made by the firm who are distributing this souvenir.

THE HARE ENGINEERING CO., LTD.

Mr. W. Almon Hare, President and Managing Director of the Hare Engineering Co., Ltd., Toronto, recently returned from a business trip to England, where he was successful in raising the necessary capital for building the company's new shops at Galt, Ont., work on which will shortly be commenced.

The Hare Engineering Co., Toronto, has taken over the business of the Standard Engineering Co., Toronto, and will continue to manufacture that company's lines of mechanical stokers, power appliances, steel heating furnaces and rolling mill equipment. In addition they will take up the manufacture of pulp and paper machinery. At Galt a site of six acres at the south end of the town has been secured and the near future will see a thoroughly modern plant in full operation there.

The directors of the company are:—Sir Ernest H. Shackleton, C.V.O., London, Eng.; Arthur Cairn Hodge, Esq., F.R.G.S., London, Eng.; W. D. Sheldon, Esq., Galt; J. F. MacGregor, Esq., Galt; Allan Hills, Esq., Galt; and J. Otty Sharp, Esq., Toronto.

Trade Gossip

The Canadian General Electric Co., Ltd., has secured control of the Allis-Chalmers-Bullock Co., Ltd., manufacturers of dynamos and other electrical machinery. The arrangements for the absorption of the latter concern by the former were recently completed. The Allis-Chalmers-Bullock Co. has a large plant at Rockfield, midway between Montreal and Lachine. The company was originally an extension of the Allis-Chalmers Co., Ltd., of the United States. The terms upon which the General Electric Co. takes over the Rockfield business are not at present available.

Professor R. J. Durley, M.Inst., C.E. of McGill University, Montreal, Que., has been awarded the Crampton prize of the Institution of Civil Engineers of Great Britain for a paper presented during the 1911-1912 session.

Mr. D. H. McDougall, assistant general manager of the Dominion Coal Company, has been appointed to the general managership of that company, which position has been rendered vacant by the resignation of Mr. J. Butler.

Charles H. Bigelow has accepted the position of chief mechanical engineer of the Millville Manufacturing Co., Millville, N. J. Mr. Bigelow recently returned from St. Catharines, Ont., where he had charge of the construction of a factory which will handle the Canadian business of the Yale & Towne Mfg. Co., Stamford, Conn.

The Gray Mfg. & Machine Co., Ltd., Toronto, Ont.; with capital of $24,000; has been incorporated, to deal in and manufacture mill supplies, engines and machinery of all kinds, also the manufacture of steel, by Alexander Gray and Catharine A. Gray, Pt. Credit, Ont.; James Gray, L. S. Gray, M. F. Gray and Robert Gray, of Toronto

Dwight O. Barret, formerly superintendent of the Manitoba Engines, Ltd., Brandon, Manitoba, is now connected with the Heer Engine Co., Portsmouth, Ohio.

Grosvenor & Co., of Canada, Ltd., Montreal, have been incorporated with a capital of, $10,000. to manufacture, import and deal in engineering and other appliances, engine room devices and specialties, by Edgar E. Rothschild, London, Eng.; Alexander Solomon, Ferdinand I. Spielmann, William Sebag Montefiore and Alexander R. Hall, all of Quebec.

S. F. Bowser & Co. are making an addition to their plant on Frazer Ave., Toronto. Business has increased 70 per cent. since last year and their new plant will be at least 200 per cent. larger than their present one. The addition will be of brick, three storeys high, and of modern construction. A warehouse and shipping shed will also be erected. The most up-to-date machinery and appliances, including automatic sprinklers for fire protection, will be installed.

The Canadian Union Electric Co., who opened an office in Montreal about a year ago are now preparing to open up in Toronto. Mr. Allan B. Wearing will be manager of the Toronto office and Mr. W. H. Bytham will look after the Montreal office. A large stock of electrical apparatus will be kept in both places.

A Dominion Charter has just been granted to **The General Manufacturers Agencies, Limited**, with head office at 515 New Birk's Building, Montreal. John G. Abraham, late with H. L. Peiler & Co., is president and general manager of the new company, which has fifty thousand dollars capital. The firm will be agents for high grade steam specialties of all kinds and will represent the Thermograde Valve Co., of Boston, for Thermograde Controlled Heating Systems; The National Regulator Co., of Chicago, for regulators; Kieley & Mueller, of New York, reducing valves and steam specialties; Benjamin F. Kelly & Sons, New York, heaters of all kinds; and the Vacuum Engineering Co., of New York, vacuum cleaners for hotels and buildings. The opening of branch offices will follow shortly.

Feed your Boilers with

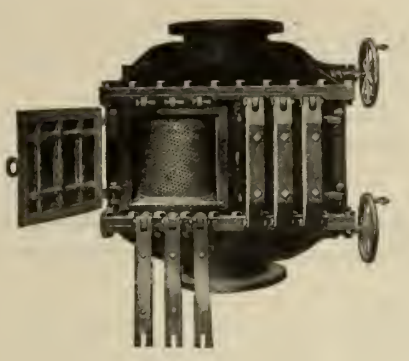
Pure Soft Water

THE SAVING EFFECTED BY USING SOFTENED WATER WILL PAY FOR THE ENTIRE COST OF INSTALLING ONE OF OUR PLANTS IN LESS THAN A YEAR.

CONSTRUCTED IN CANADA TO SUIT CANADIAN CONDITIONS.

Call or Write for Information.

G. H. TOD, 213 Manning Chambers Queen St. West **TORONTO**



Twin Strainers
Catch the Leaves

You can't keep the leaves from falling off the trees, nor you can't keep them out of the streams, rivers or lakes, but you **can** keep them out of your power plant and still get a **continuous supply** of **clean water,** if you install a **Twin Strainer** in your water line.

Keeping fish, leaves, etc., out of your plant eliminates that constant cleaning of equipment. The **Twin** is made to clean easily and quickly. **Two Valves, two Baskets—continuous flow, uninterrupted service—all sizes for all pressures.**

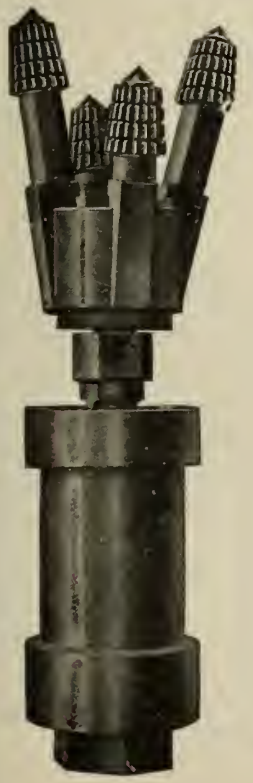
Want proof? We have all kinds. It's all in our catalogue No. 150. Write for your copy to-day.

ELLIOTT COMPANY

6902 Susquehanna Street, **Pittsburgh, Pa.**

CANADIAN REPRESENTATIVES:

Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.



They All Want Liberty Tube Cleaners

"We have 20 boilers, a total of 7,200 H.P. One man keeps all tubes clean with our *Liberty* Cleaner."

"Have tried all other kinds of Cleaners, but the *Liberty* beats them all."

"The *Liberty* is the only Cleaner we have found satisfactory on our work."

"We consider the *Liberty* machine superior to any we have used."

"On trial with the *Liberty* Cleaner and a competing machine, the *Liberty* removed 955 pounds of scale, while the other Cleaner took out 518 pounds. This trial was on two boilers of the same size, installed at the same time and operated under the same conditions."

The above are quotations from letters on file received from satisfied customers. We could fill a book with similar letters received. Let us send you a full descriptive catalogue.

Liberty Manufacturing Company

6904 Susquehanna Street **PITTSBURGH, PA.**

Canadian Representatives:

Williams & Wilson Ltd., Montreal. A. R. Williams Machinery Co., Toronto and Winnipeg.

The advertiser would like to know where you saw his advertisement—tell him.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

Vancouver.—The Norton Griffiths Steel Construction Co., Ltd., have been awarded the contract, and have already commenced work on the Merchants' Ice and Cold Storage Co's. warehouse. The building will be 300 feet long, 100 feet wide, two storeys in height, and will have a concrete basement. Reinforced concrete will be used in construction throughout. It will be fitted with rolling doors and metal window frames, and will be strictly fireproof in every respect. The cost will be $175,000. Mr. Thomas Hooper is the architect. Messrs. Norton Griffiths also have the contract for a new machine shop for the British Columbia Sugar Refinery to be erected at a cost of $35,000. Mr. J. Kennerly Bryan is the architect.

Cumberland, Vancouver Island.—The Canadian Collieries, Ltd., have had installed in Mine No. 7, Dunsmuir, a 2-ton ice making plant, machinery furnished by the Fred W. Wolf Co., Chicago, through their Seattle branch.

Penticton.—Messrs. Holden & Kelly will build a 10-ton ice making plant with cold storage in connection, contract for a 25-ton refrigerating plant and freezing system, having been let to the Triumph Ice Machine Co., Cincinnati, O.

ALBERTA.

Edmonton.—The King Edward Hotel, Edmonton, has been equipped with a five ton Armstrong refrigerating machine of the Alaskan type. The plant is being operated on the brine system.

SASKATCHEWAN.

Saskatoon.—The Swift Canadian Co. is planning to build a 7-storey cold storage house, 60 x 130 feet in dimensions, and a central meat handling plant here.

Moose Jaw.—The Polar Ice Co., Ltd., has been incorporated here with a capital of $600,000.

Regina.—Commissioner Thornton has proposed a scheme calling for the erection of a new power house to cost $500,000. The routine expenditure for electric light and power house extension for next year, if the old plant is retained, will be as follows:

One complete 1,500 unit and equipment	$40,000
Additional boilers, to furnish power for the new unit	28,500
Poles and wiring	75,000
Extension of street lighting	20,000
Meters	20,000

Regina.—The contract for the erection of the new Normal School has been awarded to the Parsons Construction Co., who will erect the structure for the sum of $200,000. The Regina Plumbing and Heating Company will install the lighting, heating and power systems.

MANITOBA.

Winnipeg.—The new plant of the Manitoba Cold Storage Co., Ltd., Can., now nearing completion here, is said to be one of the best cold storage warehouses in America. The new building is 110 x 150 feet, seven storeys and basement, affording approximately 1,100,000 cubic feet storage space, which in addition to the 500,000 cubic feet space in the old building adjoining, gives the company a total of 1,600,000 cubic feet storage capacity. The structure is of brick and reinforced concrete. The walls and floors are insulated with two 3-inch layers of Nonpareil cork board and the supporting columns with one layer of 3-inch cork board, all furnished by the Armstrong Cork Co., Pittsburg, Pa. All the rooms are protected by special cold store doors furnished by the Stevenson Co., Chester, Pa. The refrigeration is by brine circulation for all but the low temperature rooms, where direct expansion piping is used. The refrigerating machinery of 250 tons capacity was furnished by the Linde-Canadian Refrigeration Co.

Dauphin.—It is reported that the Dauphin Mineral Water Co., contemplate building a new brewery in 1913 and are investigating plans, machinery, etc.

MANITOBA.

Winnipeg.—The Board of Control of the city of Winnipeg recently called tenders relative to the supply delivery and installation of a horizontal boiler for their high pressure pumping station.

Winnipeg.—Tenders for the supply of the following equipment in connection with the extension of the artesian well water supply of the city of Winnipeg fell due on November 15.

Section "B"—Erection of 17 pump houses.

Section "C"—Supply and erection of deep well turbine pumps and meters.

Section "D"—Supply and installation of necessary voltage transformers at the individual pumping stations.

Section "E"—Supply of material for power line construction, and erection of same.

Section "F"—Supply, delivery and laying of approximately 61,000 feet of steel pipe line with valleys and specials.

Winnipeg.—Tenders were received up to November 15 for the supply and delivery of the undermentioned equipment and supplies for the fire department of the city of Winnipeg.

2-horse draw hose wagons.

2-60-H.P. motor hose wagons, gasoline or electric driven.

5,000 feet 2½ inch cotton rubber lined fire hose.

600 feet 3½ inch cotton rubber lined fire hose.

30 fire alarm boxes.

Rapid City.—The voting on the electric light by-law taken here on October 24, was practically unanimous, the figures being 74 for and 5 against. The by-law provided for the issue of $12,000 debenture stock for the purchase and erection of a complete medium electric plant by the British Canadian Engineering Supply Co. Between 100 and 150 services will be connected up at once, and the plant is expected to be self supporting. Provision is also made for the selling of power at exceptionally cheap rates as an inducement to manufacturers.

ONTARIO.

Sarnia.—At the polls on November 6, Sarnia citizens carried the waterworks by-law by a big majority; 818 being in favor and 267 against. This means that the city will spend nearly one-half million dollars to get pure water from the shore of Lake Huron, about two miles distant, and that the old intake in the river below the bay will be discarded.

St. Thomas.—St. Thomas secured another large user of Niagara power recently, when an order was received from the Empire Flour Mills, of which Mayor Price is President, for 300 horse power. The Michigan Central Railway has also commenced the use of power in its shops, starting with 125 horse power.

Niagara Falls.—The contract for the installation of a new centrifugal pump has been awarded to the Canada Foundry Company, of Toronto, their contract price being $5,700. Tenders were also received from the following: Messrs. Escher Wyss & Co., Montreal; John Inglis Co., Toronto; Buffalo Steam Pump Co., Buffalo; John McDougall Iron Works, Montreal; Drummond McCall Co.

Toronto.—Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon of Tuesday, December 10th, 1912, for the installation of one or more Fifteen Million Imperial Gallon Pumping Engines and Boilers at the Main Pumping Station. Specification and tender form may be obtained upon application at the office of Mr. James Milne, Mechanical and Electrical Engineer, Department of Works, City Hall, Toronto.

Toronto.—The Ontario Club is having its club house equipped with a 4-ton "York" refrigerating plant and small ice making system. Installation is by the Kent Co., Ltd., Montreal.

Toronto.—The Toronto Club has had its club house equipped with a 4-ton "York" refrigerating plant, brine system, and 1-ton ice making outfit. Plant was installed by the Kent Co., Ltd., Montreal, Que.

Toronto.—The Swift Canadian Co., Ltd., will add to their plant in this city two 100-ton ammonia compression refrigerating machines, furnished by the Ice & Cold Machine Co., St. Louis, Mo.

Port Edward.—The Northern Navigation Co., R. Gildersleeve, Sarnia, manager, has had plans prepared for a cold storage warehouse to be 48 x 132 feet in area, to be erected at Port Edward.

Hamilton.—The Princess Hotel Co., has had installed by the Kent Co., Ltd., of Montreal, an 8-ton "York" refrigerating machine and brine system.

Ottawa.—The Ottawa Arena Co., Ltd., has been organized by parties from Ottawa, Montreal and Toronto, including the officials of the large ice skating rink in Toronto. A site has been secured on Isabella Street from O'Connor Street to Pretoria avenue, where a large ice skating rink and ice making system are to be erected.

Renfrew.—The preliminary test of Renfrew's power plant has been made and has given unqualified satisfaction. Outside of the many citizens present there were Mr. Britcher of York, Pa., representing the water wheel makers; Mr. Clarke, of Toronto, for the generator makers; Mr. Hillis, of Hamilton, for the switchboard makers; Mr. Hamilton, of Darby, Pa., for the filter makers, and Mr. J. T. Farmer, of Montreal, representing the Drysdale pump, which he sold to the town. It took half an hour to fill the canal, after which Mr. Britcher turned on the power which gave Renfrew its first light from its own power plant. Everything worked without a hitch, and much satisfaction was expressed with the construction work, which has been under way for over two years under supervision of Town Engineer John Stewart.

Niagara Falls.—The Canadian Niagara Power Co. will spend a million and a quarter dollars to construct a new forebay at its power house in Queen Victoria Park. The capacity of the power house is being doubled, and the present forebay will be inadequate when ten turbines are in operation. The company plans to have the enlarged forebay completed early in 1915.

London.—An exhaustive report on the estimated cost of electrifying the London & Port Stanley Railways was presented to the city recently by Hon. Adam Beck. When mayor in 1902, Mr. Beck refused to ratify a lease of this line for 30 years, and gave as his reason that he believed the time would come when the city itself could electrify or in some other way equip and operate the road in such a manner as to make London to all intents and purposes a lake port. With this in mind, he had a report prepared by engineers of the Hydro-Electric Commission. The engineers estimate that the cost including reconstruction of the roadbed double-tracking the line to St. Thomas and including also adequate rolling stock will be $890,000. The total cost is made up as follows:—Reconstruction of the present track and new track, $442,573; overhead construction and binding, $129,000; passenger cars and locomotives, $235,000; substation and feeder equipment, $84,000. The report points out that the property is in very bad condition at present, and that on the 23.66 miles the city has expended $765,311. They propose that the road shall be so reconstructed that a high-speed half-hour service between London and St. Thomas, with hourly service to Port Stanley, be given. In order to estimate

the possible revenue, the engineers make a comparison of the London & Lake Erie Railway & Transportation Company, which obtained a revenue last year of $103,835 from passengers and $12,513 from freight. The total earnings of the L. & P. S. last year were $141,264, of which $92,132 was from freight. They estimate that the gross revenue after electrification will increase to $261,500, and the expenditure to $220,545.

Brantford.—Brantford ratepayers by a majority of 231 recently decided on the installation of a Hydro-Electric distribution plant, at a cost of $115,000.

Harriston.—The Harriston Town Council have awarded the following contracts for the installation of the new electric light plant, which is expected to be in operation by Dec. 15. Engine, Leonard & Sons, London; generator and other electrical equipment, other than street lamps, the Westinghouse Co., Ltd., Hamilton; street lights, the Philadelphia Electric Manufacturing Co., through Winter Joyner, Toronto. The total estimated cost of the new system is $11,000.

QUEBEC.

Montreal.—Ice Manufacturing Co., Ltd., Montreal, Canada, has been incorporated by Thomas Sargent Owens and associates with capital of $1,500,000, to conduct an ice making and cold storage warehousing business.

Montreal.—The Kent Co., Ltd., of Montreal, are installing a 20-ton "York" refrigerating plant in the new brewery recently erected in Montreal by Victor Morgeau.

PRINCE EDWARD ISLAND.

Charlottetown.—The Prince Edward Island Cold Storage Co. has let contracts for erection of a cold storage warehouse to cost about $25,000.

CATALOGUES RECEIVED.

Jenkins Bros., Ltd., Montreal, have issued the 1912 edition of their catalogue, and will be glad to mail the same free of charge to interested parties. The company are now manufacturing the well-known Jenkins Bros.' valves for superheated steam, as well as their regular line for standard, medium and extra heavy pressures. As in previous issues, packing pump valves, and other rubber specialties are also listed, and the catalogue, besides being most complete, is also very compact, measuring only 6¾x6¾ inches.

Evans, Almirall & Co. ,New York City, have mailed us an attractive booklet illustrating numerous large installations of the system of heating buildings for forced hot water circulation. Briefly stated, the system consists in heating the water by exhaust steam in closed heaters, and thereafter circulating it through the mains by centrifugal pumps.

The Electric & Ordnance Accessories Co., Ltd., Aston, Birmingham, Eng., have favored us with a copy of their catalogue F88 which deals with the patented "Eclipse" electric heaters. These are of three distinctive types:—(1) Convectors (2) Combined Convectors and Radiators, and (3) Radiators. These are attractively priced and are fully guaranteed for 5 years though their actual life is very much longer and in fact has never been fully determined.

Herbert Morris, Ltd., Loughborough, Eng., have sent us, through their Canadian office, a copy of their very complete catalogue of cranes and other lifting machinery. This is as fine a catalogue on the subject as we have seen. It contains 472 pages finely illustrated, is printed on high-grade paper and is strongly bound in cloth. The firm build all types of lifting and shifting machinery and will be glad to answer any enquiries addressed to their Canadian office at 79 Peter St., Toronto.

The De Laval Steam Turbine Co., Trenton, N.J., have forwarded a copy of the Catalogue D. This describes the De Laval multi-stage steam turbine in a very complete manner. As is well known this type of turbine, when combined with suitable reduction gearing, is particularly adapted to the driving of all slow and moderate speed machinery such as slow speed A.C. generators, D.C. generators, centrifugal pumps, fans and blowers, etc., etc. The catalogue contains a useful chart and scale by means of which the steam consumption of a perfect engine or turbine can be simply determined for any given steam conditions, thereby comparing the steam consumption of the perfect heat motor with that of an actual heat motor, the efficiency ratio of the latter is found.

CLASSIFIED ADVERTISING

FOR SALE

FOR SALE—A CORLISS ENGINE 13 X 30, drive wheel 12 ft. diam., 18 in. face; in A1 order. Can be seen running. Apply Box 118, Power House. (11)

BELTING FOR SALE—800,000 FEET OF best quality leather, rubber, hair and canvas belting, bought from bankrupt manufacturers at 25% to 75% less than the regular value. Also a large quantity of slightly used belting, piping, chains, rails, pulleys, hangers, cotton waste, etc., at very low prices. Send for catalogue. Imperial Belting and Supply Co., 5 Queen Street, Montreal.

SALESMEN WANTED

LAKE ERIE BOILER COMPOUND CO. Require a few first-class representatives to sell their well-known compound. Liberal commission paid to live men, and exclusive territory. Write at once, giving references, 11 Colborne St., Toronto. (tf)

WANTED

MOST FAVORABLE TERMS WILL BE given to any firm wishful to take up sole agency for our Patent Flexible Metallic Face Steam Packings. S. Redfern & Co., Swan Lane, Manchester, England. (11)

WANTED—AN ENGINEER WITH A SUFFICient knowledge of electricity to lay out and superintend the installation of steam boilers, engines, dynamos, lines, etc., in a new manufacturing plant. Good place for the right man. Address O. B. Mueller, care of Mueller Mfg. Co., Limited, Sarnia, Ont. (11)

WANTED — EVERY POWER HOUSE IN Canada to remember that C. E. Shedrick, Craig Street West, Montreal, is still repairing measuring instruments, both switchboard and portable. Twenty-five years' experience in repairing all kinds and makes on the market. Integrating meters repaired, tested and sealed, and returned on quick time.

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Dixon's Flake Graphite No. 1.
This is the standard size of Dixon's Ticonderoga Flake Graphite, and is recommended for general lubricating requirements.

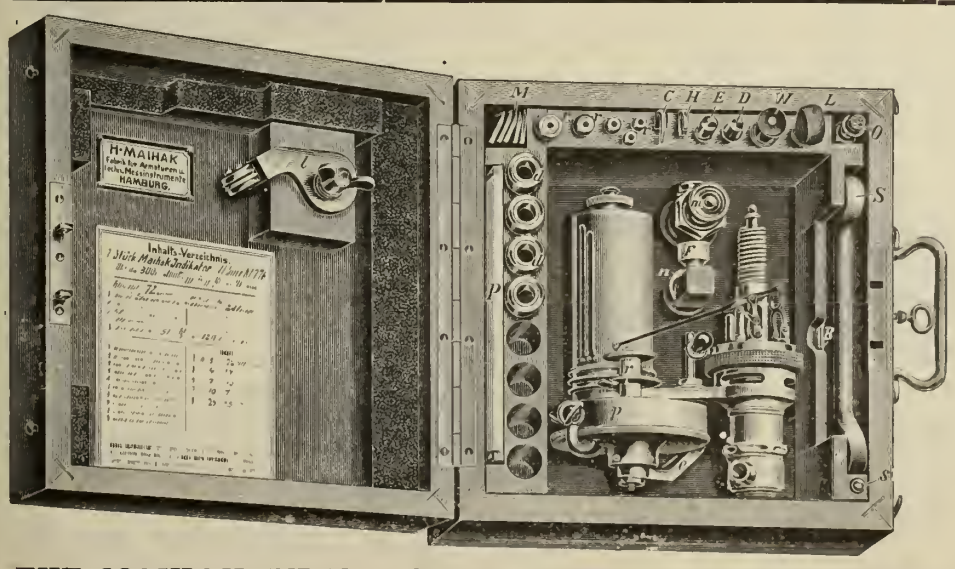
Dixon's Flake Graphite No. 2
A more finely ground graphite than No. 1, though of the same stock. This is adapted to close-fitting bearings and delicate mechanism.

Dixon's Special Graphite No. 635
This is a selected grade of Dixon's Ticonderoga Flake Graphite ground even finer than the No. 2 Flake. It is widely used in stationary gas engines. This grade of graphite is also used on type-setting machinery.

Dixon's Waterproof Graphite Grease
A strongly adhesive grease of heavy body; cannot be washed off by fresh, salt, alkaline, or acid water. Especially adapted for wire rope, gears, slides, chains, elevatorways, mining and quarrying machinery, and generally on machinery exposed to water or the weather.

"Graphite As A Lubricant," and Sample 222C free.

JOSEPH DIXON CRUCIBLE CO.
Jersey City, N.J.



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This indicator made in Germany is the best in the world.

Outside spring, and easily exchanged.

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Pemco Tungsten Fixtures

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INDUSTRIAL and STREET LIGHTING

They are all

SIMPLE, DURABLE and EFFICIENT.

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ALL LUBRICANT—NO WASTE

A small quantity of Albany Grease lasts longer than a large quantity of any other lubricant. It's wasteless, and the greatest natural friction reducer.

A sufficient quantity of Albany Grease, an Albany Grease Cup, and our new book, "Death to Friction," will be sent without charge upon receipt of your name and address. Why not take us up?

At your dealer's—if not order direct

ALBANY LUBRICATING CO., Sole Makers

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708-710 Washington St. NEW YORK

"Monowatt" Tungsten

Incandescent Lamps

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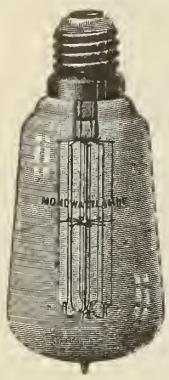
Carbon 3 1-2 "Watt"

Incandescent Lamps



First quality lamps in stock in every candle power at lowest prices.

G. LEWIS

Sole Distributor

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MONTREAL

Notice to Stationary Engineers

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HON. J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto

Ideas at 2 Cents Each

¶ An idea that's worth anything at all to a Power Plant man is worth more than two cents.

¶ It might be worth hundreds of dollars.

¶ Every issue of "THE POWER HOUSE" is full of practical, helpful ideas. You ought to be able to sift out four each month that would prove of some use to you. Put a value of two cents on each and your subscription has been paid.

¶ You cannot afford to miss even one issue—you might miss the idea that would be worth hundreds of dollars.

¶ The date on the label of your "POWER HOUSE" wrapper shows when your subscription expires. One dollar will renew it for a year.

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Neglect blew up the Boiler

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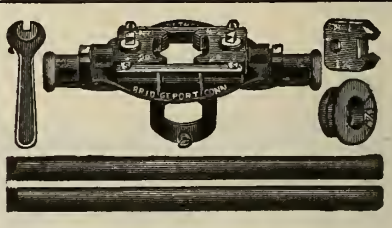
USED AND ENDORSED BY THE LEADING DEALERS
SOLD ALL OVER THE WORLD



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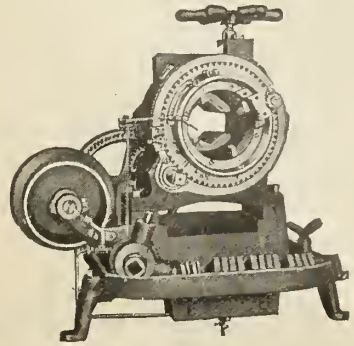

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Simple, economical, reliable, durable, highest efficiency.

Save the labor of from one to four men with our hand machines and power machines; require one quarter the floor space and one half the power of the lathe bed type.

Can you afford to be without one?
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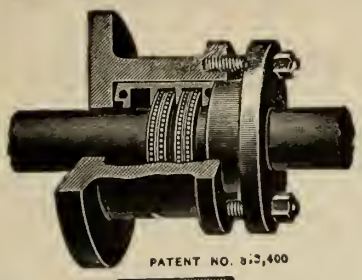

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Metallic Packing

is Guaranteed 3 years.

Lasts many times longer. 30 days trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

ALLIGATOR BELT LACING

FLEXIBLE STEEL

Makes Joints Quickly.

Only a Hammer Required.

No Holes to Punch.

Forms the Strongest Part of The BELT.

Let Us Send One On Trial.

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The only union made absolutely Non-Corrosive. Brass to iron in all contact points. Ball joint; Octagon ends, any wrench can be used. Adapted for heavy service. Every union air tested at factory. Send for circular B, describing the above and other fittings made by

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We are supplying the largest manufacturing plants, power houses and machine shops throughout the Dominion.

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We also are manufacturers and large importers of cotton and wool waste. We can quote the very best prices.

Prices and samples of both waste and wipers sent free on request.

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Mueller Pressure Reducing and Regulating Valves

Give accurate and absolute control of pressures of water, steam, air, gas, oil, carbonic and acetylene gases—in fact, all kinds of pressures. Their efficiency is firmly established. Manufactured under Canadian patent No. 127,566. Address:

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Manufacturer for The H. MUELLER MFG. CO., Decatur, Ill., and New York City.

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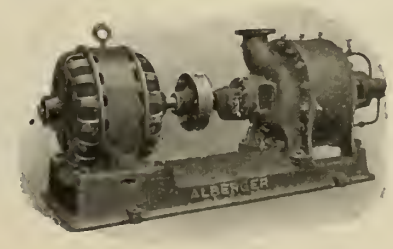
SURFACE and JET CONDENSING EQUIPMENT



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McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.

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26 Craig St. MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.

452 Concord Ave., TORONTO, ONT.

The advertiser would like to know where you saw his advertisement—tell him.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

Have you ever seriously considered the necessity of mingling freely with your fellow-men whose life's occupation is the same as your own? If you have not, I would like to place before you the advantages which accrue to all thus associated.

We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

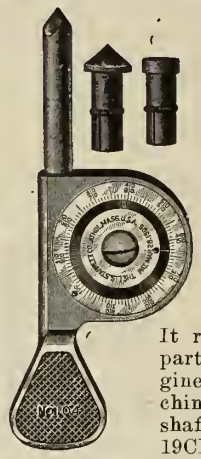
In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

A. KASTELLA
Executive Secretary
STRATFORD, - - - ONTARIO

Never Guess On Your Engine Speed

You will either overtax it, which will necessitate costly repairs, or else you won't get all the power that is in it. The proper way to accurately determine the speed of any engine or machine is to use a



Starrett Speed Indicator

It registers any speed without heating of parts. Equally good for motors, gas engines, line shafting, or any revolving machine. Rubber tips for centred or pointed shafts. Send for Starrett Catalogue No. 19CD.

The L. S. Starrett Co.
Athol, Mass.

NEW YORK
150 Chambers Street

CHICAGO
17 No. Jefferson Street

LONDON
36 & 37 Upper Thames Street, E. C.

42-33

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC
METALLIC PACKING
LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD

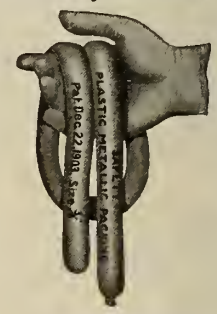
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5000 pounds per square inch
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars

Manufactured only by

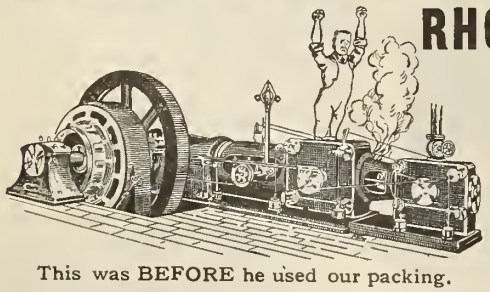
STEEL MILL PACKING CO. : WINDSOR, ONT.

Practically Frictionless



Sold on APPROVAL

RHODES IMPROVED METALLIC PACKING

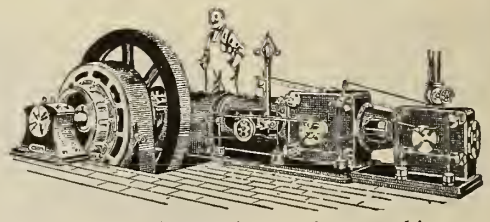


This was BEFORE he used our packing.

THE PACKING THAT PACKS

A trial will convince you.

Beware of Imitations.



This is AFTER he installed our packing.

WRITE TO-DAY FOR PARTICULARS

The Rhodes Improved Metallic Packing Co., Limited
55 St. Francois Xavier Street, - - - MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.

Thousands in use and every user a booster of

S. & S. TACHOMETERS

We have them in every size and style, both portable and stationary.

Change from one speed range to another is effected by shifting a thumb slide while shaft to be tested is running

They tell you instantaneously and indicate accurately the capacity of your machines.

DON'T GUESS any more —it is costing you money.

Our New Catalogue is now ready, we want you to have one if you are interested.

Schuchardt & Schutte, 307 Coristine Building Montreal

HEAD OFFICE AND FACTORY—TORONTO

GET OUR PRICES FOR

Copper, Tin, Lead
Zinc, Babbitt, Solder
Lead Pipe

WE ARE HEADQUARTERS FOR ALL INGOT METALS

The Canada Metal Company, Limited

HEAD OFFICE AND FACTORY Fraser Avenue, TORONTO

Branch Factories—MONTREAL and WINNIPEG

The advertiser would like to know where you saw his advertisement—tell him.

MADE IN CANADA

The Lowest in Cost and Best

High Pressure Gaskets

On the Market

Because 1. They are permanent. 2. They are easy to apply. 3. They are easy to remove. 4. It is impossible to blow them out. 5. They will not stick to the metal. 6. They can be used over again. 7. They are not affected by high temperature. 8. Cleaning the joints after using these gaskets is unnecessary. 9. There is no danger of of damaging the gaskets in breaking or making the joint over. 10. There is no time lost in preparing these gaskets for the joint. They are always ready.

Write us at once for circulars and prices, and avoid duty.

CANADIAN GASKET COMPANY
BRIDGEBURG, ONT.

The Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars and a Trial Trap.

Canadian Morehead Mfg. Co.
WOODSTOCK, ONT.

YOU WANT TO IMPROVE YOUR POSITION

THEN READ THE

LIFE OF JAMES WATT

INVENTOR OF THE STEAM ENGINE

By ANDREW CARNEGIE

An entertaining book for those interested in mechanics and power, dealing with the scientific and mechanical inventions of Watt's life and times and his relations with other noted scientists and inventors.

The author, as a practical engineer, possesses all the technical knowledge necessary to give actuality to his writing, and his book is alive with enthusiasm and appreciation. He has missed no point in the romance of Watt's career, with its many thrilling episodes and its study of human nature revealed in a realistic manner. Mr. Carnegie may not point out how to become a millionaire, but he certainly sets forth considerations which may help to influence many a working man to improve his position.

Cloth Bound. 164 Pages. Postpaid, $1.00.
OR FREE to subscribers who send in two new subscriptions to Power House.

TECHNICAL BOOK DEPARTMENT
MacLean Publishing Co. - 143-149 University Ave., Toronto

HOMESTEAD STRAIGHTWAY VALVES

ALWAYS OUTLAST OTHER VALVES

For Pressure Up to 5000 lbs. per. Sq. In.

The reason is very evident.

Where the common Globe and Gate Valves have their vital parts—the seats—exposed to pressure and constant wear, every minute they are open, the seat of the Homestead Straightway is never exposed.

The plug is balanced and held in place by the pressure when open, and when closed it is locked in the seat by our patent wedging cam, insuring freedom from friction in the seat while the plug is turning and making the Homestead the quickest acting, the simplest, the most easily operated and the most durable valve known.

Let us send full details. Write

Homestead Valve Mfg. Co.
PITTSBURG, PA.

The advertiser would like to know where you saw his advertisement—tell him.

GRAPHITOL

Pat. and Trade Mark Reg'd.

The graphite cement bearing material.
Another step in the ladder of progress.
A distinct advance over babbitt metals.
The most frictionless material yet produced.
A thorough success.

Write for free illustrated pamphlet describing this material, to

British Pacific Supply Company

F. C. Winkler, Manager,

VICTORIA, B. C.

MAKERS OF GRAPHITOL.

Get More Service From Your Machinery!

NUMIDIAN CYLINDER OIL
VELOX ENGINE OIL

EVERY GALLON GUARANTEED

THESE OILS WILL HELP YOU!

If you are not using our Numidian Cylinder Oil or Velox Engine Oil, give them a trial. You will be surprised at the difference in the running of your machinery.

These high grade oils sell at a reasonable price—a price which will appeal to you.

Write for samples.

C. C. Snowdon

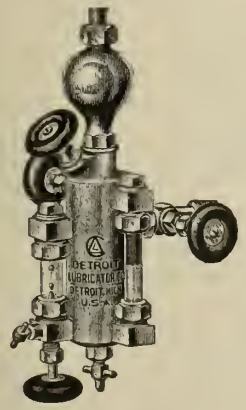
Wholesale

P.O. Box 1384. CALGARY, ALTA.

New Detroit Catalog

The big, new 232 page Detroit catalogue is complete in every way.

It shows a full line of lubricators for every condition met with on every kind of steam engine, steam pump, air compressor, ammonia cylinder. It fully illustrates and describes Detroit locomotive lubricators and specialties, mechanical force feed oilers for gas engines, hand pumps, glass oilers, brass oilers, grease cups, ground key work, water gauges, fusible plugs and other boiler trimmings, valves, and a multitude of other devices.



It shows repair parts for all Detroit Lubricators, gives complete instructions for their installation, care and operation, and contains valuable information on the general subject of lubrication.

This book will help you with your work

If you would like to know more about lubricators and lubrication, this book should contain the information you want. If it doesn't our Engineering Service Department will be glad to help you.

Write for catalogue G-58.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

Windsor, Ont.

From Factory to Consumer

Dominion Babbitt Metals are more generally used where known than any other make in the market.

There is a reason for this—they are sold on merit—every pound fully guaranteed.

We specially commend to users of Babbitt Metal the following Dominion brands of Babbitt as representing the best formulae used in the Engineering World to-day:—

"Genuine" "Special Hard"
"Eagle Genuine" "Metallic Packing"
"Delta Genuine" "Beta Copperized"
"Copper Tough" "Maple Leaf"

Furthermore, these babbitt metals are not only of the most improved design, but COST THE CONSUMER LESS MONEY than other widely advertised babbitts. Our Prices are named F.O.B. your Station.

Let us tell you about them, and submit you descriptive catalogue—invaluable to any Engineer.

Have you seen one of our Pipes? One mailed free to any Engineer on request.

The DOMINION METAL COMPANY

N. B. Prichard, Engineer and Manager

SHERBROOKE, P. Q.

Your Broken or Damaged Machinery

Can be Made as Good as New, Quickly, by our Process of

AUTOGENOUS WELDING

And you won't lose money by holding up your plant while renewal parts are being made.

By this system metals are united without soldering or compression. The welded part is practically as strong, if not stronger, than the rest of the metal.

When trouble occurs telephone or telegraph us. Our expert operators and our emergency repair outfit will be at your shop as quickly as the next express trains can transport them.

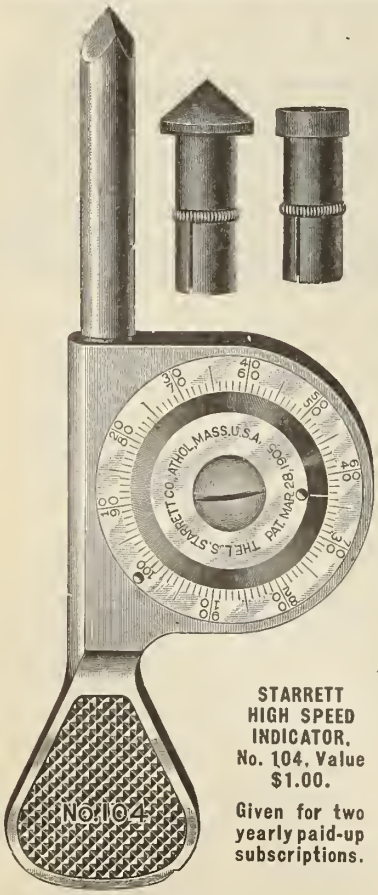
No work too large or too small for our capacity. Send your small broken parts by express. We will give them our prompt attention. We pay charges one way. Be convinced as to the high quality and economy of our work—send us a trial job. We guarantee satisfaction.

Our long distance Telephone numbers are :
DAY CALLS---Adelaide 198. NIGHT AND SUNDAYS---Hillcrest 431.

THE FRANCO-CANADIAN WELDING CO.

331 YONGE STREET TORONTO

Get our Name and Address firmly fixed in your mind. You will need us in a hurry some day.



STARRETT HIGH SPEED INDICATOR. No. 104. Value $1.00.

Given for two yearly paid-up subscriptions.

You May Have This Speed Indicator without Spending a Cent

if you are a subscriber to "THE POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two yearly paid-up subscriptions we will send this $1.00 Indicator.

"THE POWER HOUSE' is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

PUBLISHED MONTHLY AT $1.00 PER YEAR
Start in TO-DAY to earn one of these Handy Tools.

THE POWER HOUSE 143 University Ave, Toronto

The advertiser would like to know where you saw his advertisement—tell him.

The Big Question of the Hour

How to Convert Waste Into Profits

That's the big question that is commanding attention in every great industrial plant to-day!

As competition grows keener, it becomes more evident that the profits of to-morrow will be taken out of the wastes of to-day!

DEARBORN TREATMENT PREVENTS WASTE IN THE BOILER ROOM

By preventing scale formation, corrosion, pitting, foaming, and all feed water troubles, it gives greatly increased steaming efficiency without increase of boiler capacity—effects large reductions in fuel expense—cuts down boiler repair cost, and prolongs the life of your investment in your boilers.

These big economies warrant your investigation of Dearborn methods of water treatment. Send gallon Sample of your boiler feed supply for analysis, and we'll advise with you regarding special treatment to correct the troublesome conditions at your plant.

Dearborn Drug & Chemical Works

General Offices, Laboratories and Works, Chicago

Would you like to Spend your Sundays at Home?

Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

YOU can reduce the labor and expense of boiler cleaning and cut down your consumption of fuel by using

McCOLL'S Special Boiler Compounds

or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

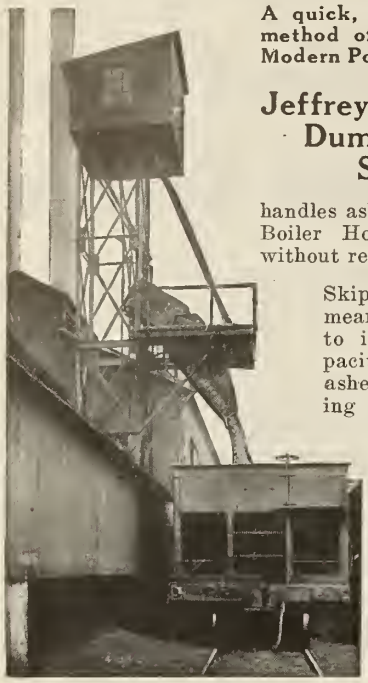
Our Boiler Compounds are like our Oils—BEST by TEST

WRITE FOR PARTICULARS TO

McCOLL BROS. & COMPANY

Montreal, Toronto, Winnipeg or Vancouver

The advertiser would like to know where you saw his advertisement—tell him.



A quick, easy and economical method of handling ashes in a Modern Power Plant.

Jeffrey Automatic Self-Dumping Electric Skip Hoist

handles ashes direct from floor of Boiler House to Railroad cars without requiring any hand labor.

Skip Car is lowered by means of automatic hoist to its starting point. Capacity, 125 cubic feet of ashes per hour. Operating parts are fully enclosed from dust, and moisture proof.

Mechanical brake automatically holds the load when the motor is at rest, and also prevents excessive speed in lowering.

Catalogue 32-A shows how Jeffrey Coal and Ashes Handling Systems have reduced power costs in over fifty different power plants. Ask for a copy.

JEFFREY MANUFACTURING CO.

Canadian Works and Main Office, MONTREAL
Winnipeg Representatives N. J. DINNEN & CO.

TIME AND LABOR SAVING MACHINERY

WITH LOW COST OF MAINTENANCE

Equipments for the Low Cost of Handling Materials

—

Conveying and Elevating Machinery

—

Power House Coal and Ash Handling Systems

—

Direct and Steam Heating Dryers

—

Sand and Gravel Machinery

—

Mining Equipments, Tipples, etc.

—

Screens, Hoists

You can greatly increase your profits by using machinery to do your work instead of employing a number of men. The first cost of our machinery is practically the only cost—after that is covered there is nothing but profit.

Do not continue the old way—change your methods at once and you will be surprised with the results obtained after installing the modern way of handling materials.

Our Engineering Staff is at your service—they will develop machinery to meet your conditions.

Write for particulars.

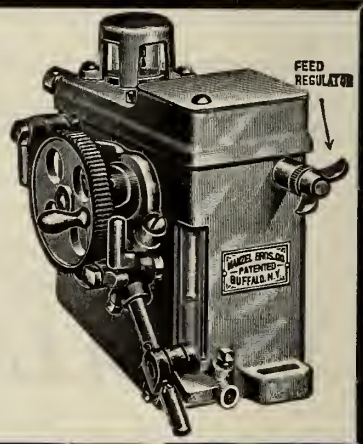
The C.O. Bartlett & Snow Co. of Canada
Limited
282 St. Catherine Street West, MONTREAL

Let Us Send You a Manzel Oil Saving Oil Pump on Thirty Days' Trial.

30% OIL SAVING GUARANTEED

You may be able to save as high as 60%. Many others have done so. The "Manzel" New Model Oil Saving Oil Pump is a positive lubricator. It oils the cylinders right all the time, and makes a big reduction in oil bills, besides saving labor and wear and tear on the engine.
You can try a "Manzel" Pump with the distinct understanding that it may be returned at our expense if it doesn't reduce your oil bills at least 30%.
Send for one on these conditions.

Write for catalogue and full particulars.



THE TWIN CITY OIL COMPANY
General Agents Ontario and Quebec, Berlin, Ontario
Manzel Brothers Company, Buffalo, N.Y., U.S.A.

When All Others Fail

GERMAN VALVE CYLINDER OIL,
GERMAN ENGINE OIL,
STERLING FAST ENGINE AND DYNAMO OIL,
STERLING FRICTIONLESS COMPOUND

will cure your troubles.

Canadian Oil Companies Limited,
Toronto, Winnipeg, Montreal, St. John, Halifax, Calgary.

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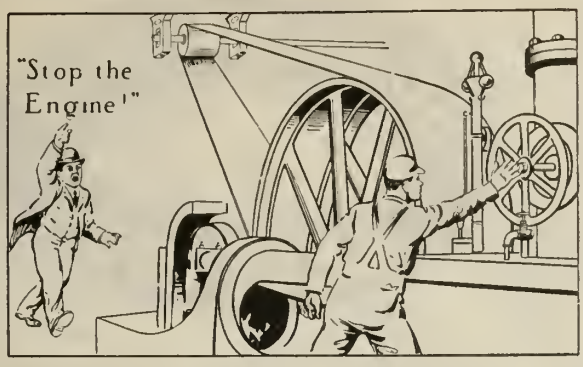


Without Cling-Surface things will happen

W. V. Ford had a good story in Power (October 17, 1911):—

Down south in a cotton mill belts got to stretching badly after three weeks of rainy weather. Boss said, "Take 'em all up—main belt too." The millwright obeyed the boss, and took from 6 to 10 inches out of each belt. "When I started up," says Ford, "the fun began. Both bearings went hot. Manager turned water on the bearings. Boxes on main driving shaft melted out. One 10 inch belt broke; others ran off. Manager came running, yelling at the top of his voice to stop the engine. Owner fired the manager. It took three and a half days' work rebabbitting the boxes and letting out and splicing the belts before the mill could be run again."

This is some contrast to the orderly belt conditions where Cling-Surface is used consistently, for Cling-Surface-treated belts are not affected by the weather. Satisfactory belt service is made possible by Cling-Surface in far away Java where the dampness is intense, in Egypt where heat and absence of moisture dry out untreated belts, and in every other country where civilization exists. In fact, Cling-Surface makes belts dependable, durable, non slipping, pliable, and efficient regardless of natural humidity and temperature.

Live engineers are fast waking up to the folly of running belts tight. We don't question that belts systematically tightened can do good work, but belts systematically treated with Cling-Surface and run slack do better work. Besides, Cling-Surface treatment takes less time and money than repairs on tight belts, the lessened tensions make possible the delivery of more power, less energy is dissipated into preventable friction, and there is also a saving of oil, bearings, steam, coal and worry.

Free advice, literature and positive proof of results from Cling-Surface treatment are yours, if you will only ask.

Cling-Surface Co
1057 Niagara Street Buffalo N Y
49

This brand of leather belting Costs less per day of service than any other

LEATHER BELTING
(WATERPROOF)

Get some and keep tab on it.

Sadler & Haworth
Tanners and Manufacturers

MONTREAL 511 William St.
TORONTO 27 Melinda St.
ST. JOHN, N.B. 89 Prince William St.
VANCOUVER 217 Columbia Ave.
WINNIPEG 244 Princess St.

For over 35 years the makers of the best leather belts which does make a difference to you.

GEO. BOOTH, PRESIDENT — WALTER G. MANNY, VICE-PRESIDENT — WALTER E. BOOTH, SEC'Y-TREAS.

TELEPHONE MAIN 2648

BRITISH AMERICAN METAL CO. LIMITED

115 SUMACH STREET
TORONTO, ONTARIO April, 4.1911.

QUOTATIONS SUBJECT TO CHANGE WITHOUT NOTICE. ALL AGREEMENTS CONTINGENT UPON STRIKES, ACCIDENTS, DELAYS OF CARRIERS AND OTHER DELAYS UNAVOIDABLE OR BEYOND OUR CONTROL.

The Federal Engineering & Supplies, Ltd.,
284 Yonge St.,
Toronto.

Dear Sirs:-

We are glad to report that the Scandinavia Belting which you sold us has given us great satisfaction, and we find on straight drives it is an excellent belt.

One belt which we bought from you for a Motor Drive is working exceedingly well, and we greatly like its flexibility and straight run.

Yours very truly,

The BRITISH AMERICAN METAL COMPANY, LIMITED.

P. P. Miller.
Manager.

FPM/VAE

SCANDINAVIA
FEDERAL ENGINEERING & SUPPLIES LIMITED
TORONTO
BELTING

We would draw your attention to the accompanying letter, which is another reason why Scandinavia Belting gives satisfaction.

Sole Agents for Canada:

FEDERAL ENGINEERING & SUPPLIES LIMITED

Toronto Montreal

LOOKING FOR THE "MAPLE LEAF"

is increasingly a habit with those who buy much Belting.

The reason is not hard to find, for there is no part of your Belting system, from the main drive to the smallest light Belt for power transmission, where you will not get the best kinds of service from

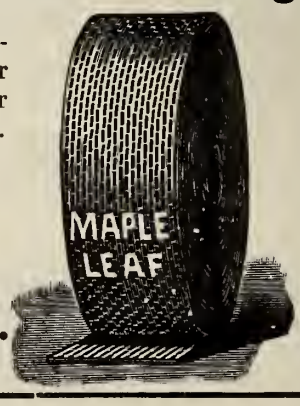
"MAPLE LEAF" BRAND Stitched Cotton Duck Belting

It is the most economical Belting because it is durable under every condition; even where other Belting will deteriorate rapidly. It is water proof.

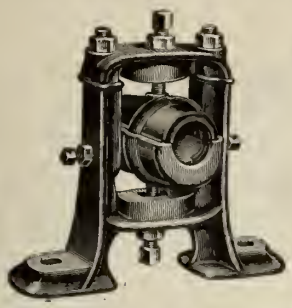
It runs absolutely true on the Pulleys.

It is built of plies of selected duck.

Write for Information and Prices.



DOMINION BELTING CO., Ltd.
HAMILTON, CANADA

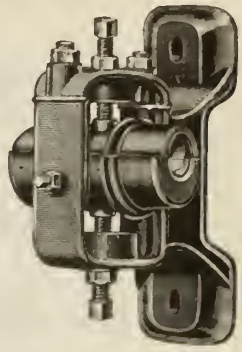


Bond Universal Pillow Block.

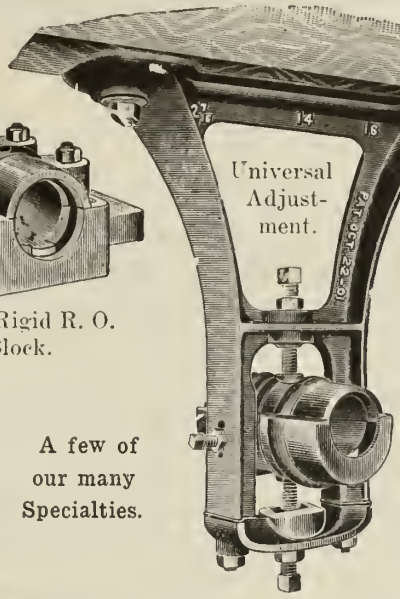
Make Assurance "DOUBLE SURE" and take a "BOND"

All Bearings Babbitted and Reamed

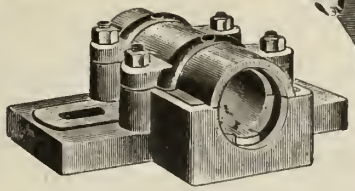
The "Bond" Patent Universal Ring Oiling Ball and Socket Hanger.



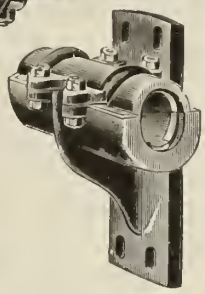
Bond Post Hanger.



Universal Adjustment.



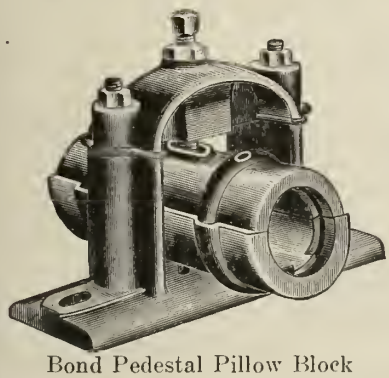
The "Bond" Rigid R. O. Pillow Block.



Bond Rigid R. O. Post Box

SEND US YOUR INQUIRIES.

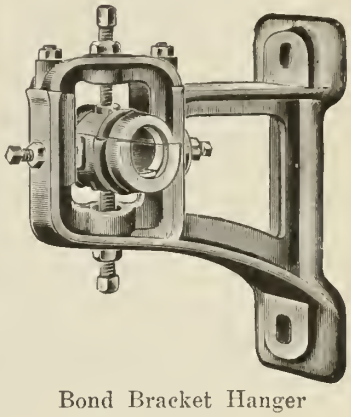
SEND FOR COMPLETE CATALOG "Y"



Bond Pedestal Pillow Block

A few of our many Specialties.

A trial order will convince you of its superior merits.



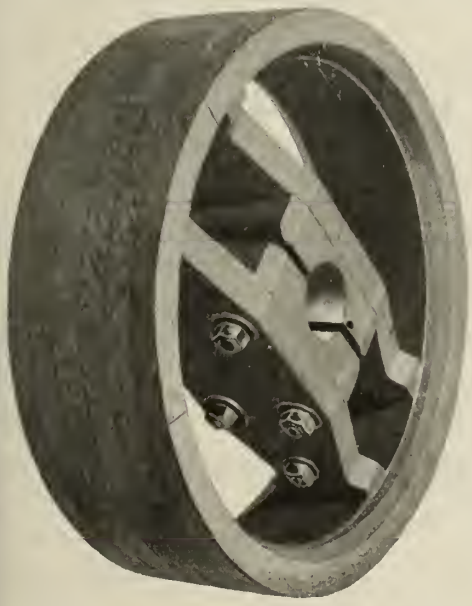
Bond Bracket Hanger

Canadian Bond Hanger & Coupling Co., Ltd.

Manufacturers

ALEXANDRIA ONTARIO

A Combination Hard to Beat



Elmira Ball and Socket Hangers

Elmira Wood Split Pulleys

The Elmira B. & S. Hangers are designed to meet the hardest and most exacting conditions. They are of good weight, correct design, and well proportioned. A Duplex system of oiling is employed consisting of tempered steel rings and woven cotton wick.

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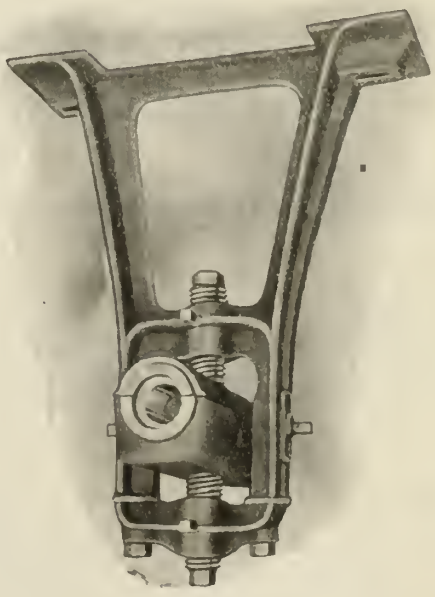

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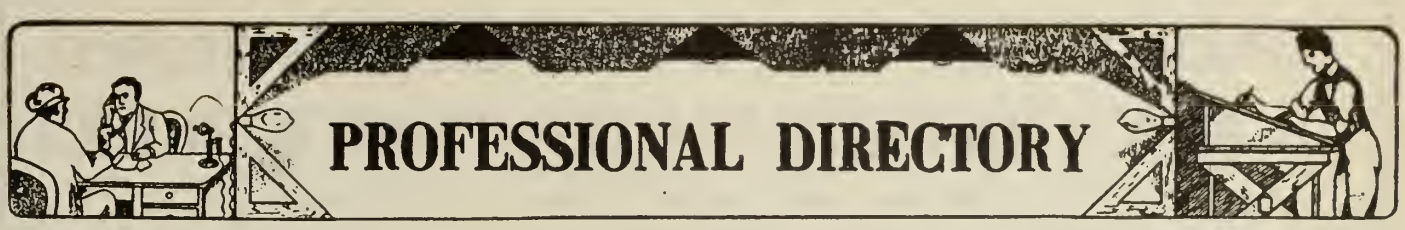

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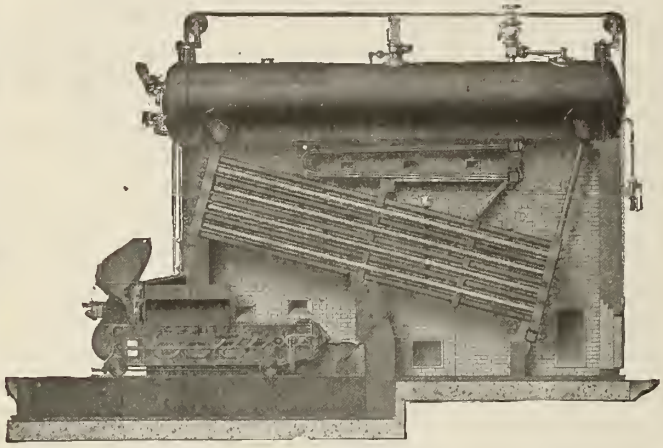

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British Pacific Supply Co., Victoria, B.C.

Grates.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Ltd.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.
Geo. H. Tod, Toronto.

Grease Cnps.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
Detroit Lubricator Co., Detroit.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
F. J. Schuch, Toronto.

Grease and Oil Extractors.
Canada Foundry Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary.
Hare Eng. Co., Toronto.
Steam Appliance Co., Milwaukee, Wis.

Greases.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria, B. C.
Can. Fairbanks-Morse Co., Montreal.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Hangers.
Can. Bond Hanger & Coupling Co., Alexandria.
C. O. Bartlett & Snow Co., Montreal
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery and Transmission Co., Elmira.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Heaters.
Alberger Condenser Co., New York.
Canada Fonndry Co., Toronto.
Darling Bros., Montreal.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Hare Eng. Co., Toronto.
E. Leonard & Sons, London, Ont.
H. L. Peiler & Co., Montreal.
The Sims Co., Erie, Pa.

Hoists.
C. O. Bartlett & Snow Co., Montreal

Hose, Flexihle Metailie.
F. J. Schnch, Toronto.

Hose, Steam, Snetlon and Water.
Dunlop Tire & Rnbber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.

Hydraulic Aeeumulators.
Canada Foundry Co., Ltd., Toronto.

Hydraulie Machinery.
The Deming Co., Salem, O.

Hydraulic Presses.
Bawdon Machine Co., Toronto.

Hydro Extractors.
Jones & Glassco, Montreal,

Ice Making Machinery.
Linde British Refrigeration Co., Montreal.

Indieators, Electric—All Types.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Indicators, Steam and Gas Engine.
Can. Fairbanks-Morse Co., Montreal.
H. L. Peiler & Co., Montreal.
The Maihak Indicator Agy., Montreal.

Indicators—Ammonia, Hydraulie.
Detroit Lnbricator Co., Detroit.

Indicating.
Renown Engine & Machine Co., Montreal.

Injectors.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.

Insniating Compounds.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Insniating Tapes & Varnishes.
Standard Undergronnd Cable Co., of Canada, Ltd., Hamilton, Ont.

Furnaces.
Monarch Electric Co., St. Lambert, Que.

Iron Filler.
Imperial Waste & Metal Co., Montreal.

Lamps, Tnngsten, etc.
Canadian General Electric Co., Ltd., Toronto.

Lamps, Are, Incandeseent.
Canadian General Electric Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton
P. H. Klein, Jr., Co., Montreal.
Northern Electric & Mfg. Co., Limited, Montreal.
A. H. Winter Joyner, Toronto.

Lubricants.
Adams Cooks Son, New York.
Albany Lnbricating Co., New York.
British Pacific Supply Co., Victoria,
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Lnbricators, Force Feed.
Adams Cooks Son, New York.
Albany Lnbricating Co., New York.
Darling Bros., Montreal.
Can. Detroit Lubricator Co., Windsor.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N.Y.

Lnbricators, Plain.
Can. Detroit Lubricator Co., Windsor, Ont.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.

Mats.
Dunlop Tire & Rnbber Goods Co., Toronto.

Mechanical Stokers.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Ltd.
Fraser & Chalmers, Ltd., Montreal.
Hare Eng. Co., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.

Metal Cntting (Oxy-Hydrogen).
Franco-Can. Welding Co., Toronto.

Metal Welding.
Franco-Can. Welding Co., Toronto.

Meters, Electrie.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Monarch Electric Co., St. Lambert, Que.

Meters, Water.
H. L. Peiler & Co., Montreal.

Miea.
Kent Brothers, Kingston, Ont.

Miii and Mining Machinery.
Can. Fairbanks-Morse Co., Montreal.
Fraser & Chalmers, Ltd., Montreal.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
Jenckes Machine Co. Sherbrooke, Que
Robb Engineering Co., Amherst, N.S.
Railway Equipment Co., Toronto.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Molds, Rubber.
Bawdon Machine Co., Toronto.

Motors.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal.
Railway Equipment Co., Toronto.

Motor Starters and Controilers.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Office Railings.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Cups.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.

Oilers, Multipie.
Can. Detroit Lubricator Co., Windsor,
Lunkenheimer Co., Cincinnati, O.

Oil Fliters.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Jas. Morrison Brass Mfg. Co., Toronto.
The Sims Co., Erie, Pa.

Oil Separators, Ammonia.
Steam Appliance Co., Milwaukee,

Oil Separators.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Liberty Mfg. Co., Pittsburg.
Jas. Morrison Brass Mfg. Co., Toronto.
Steam Appliance Co., Milwaukee.

Oils, Lnbricating.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria.
Can. Oil Companies, Ltd., Toronto.
Dearborn Drug and Chemical Works Chicago.
C. C. Snowdon, Calgary.

Oxy-Acetyiene Welding.
Franco-Can. Welding Co., Toronto

Packing Engine.
Can. H. W. Johns-Manville Co., Toronto.
Dunlop Tire & Rnbber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Canada, Ottawa
Steel Mill Packing Co., Windsor, Ont.

Packing, Metaliic.
General Supply Co. of Canada, Ottawa
Holmes Metallic Packing Co., Wilkesbarre, Pa.
H. L. Peiler & Co., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.
Rhodes Improved Metallic Packing Co., Ltd., Montreal.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
General Supply Co. of Canada, Ottawa
Steel Mill Packing Co., Windsor, Ont

Packing, Sheet.
Dunlop Tire & Rnbber Gods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
General Supply Co. of Canada, Ottawa
Quaker City Rubber Co., Philadelphia, Pa.
F. J. Schuch, Toronto.

Packing, Ammonia, Steam and Water.
Canadian H. W. Johns-Mansville Co., Toronto.
Dunlop Tire and Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
General Supply Co. of Canada, Ottawa
Quaker City Rnbber Co., Philadelphia, Pa.
F. J. Schuch, Toronto.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rubber.
Dunlop Tire and Rubber Goods Co., Toronto.

Panel Boards.
Devoe Electric Switch Co., Montreal.
Hill Electric Switch Co., Montreal.

Paeking Rnbber.
Dunlop Tire and Rubber Goods Co., Toronto.

Patents.
Rowland Brittain, Vancouver, B.C.

Penstocks.
Canada Foundry Co., Ltd., Toronto.
Canadian Booving Co., Toronto.

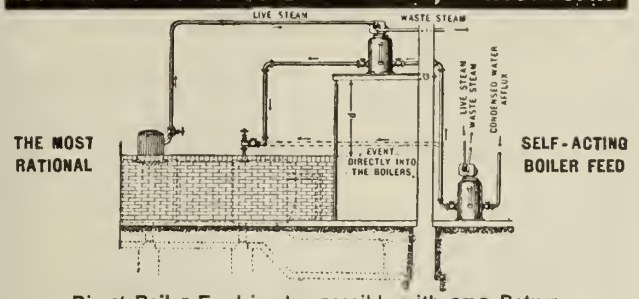
Penstock Lugs.
Otterville Mfg. Co., Otterville, Ont.

Schneider & Helmecke, Magdeburg Germany

RETURN STEAM TRAP FOR FEEDING BACK HOT CONDENSED WATER DIRECT TO BOILER, WITHOUT PUMP.

Founded A.D. 1878 — Special Works for Steam Traps

GREAT SAVING IN COALS AND WORKING EXPENSES
INCREASED BOILER EFFICIENCY.
INCREASED LIFE OF BOILER.
MINIMUM OF BOILER INCRUSTATION.

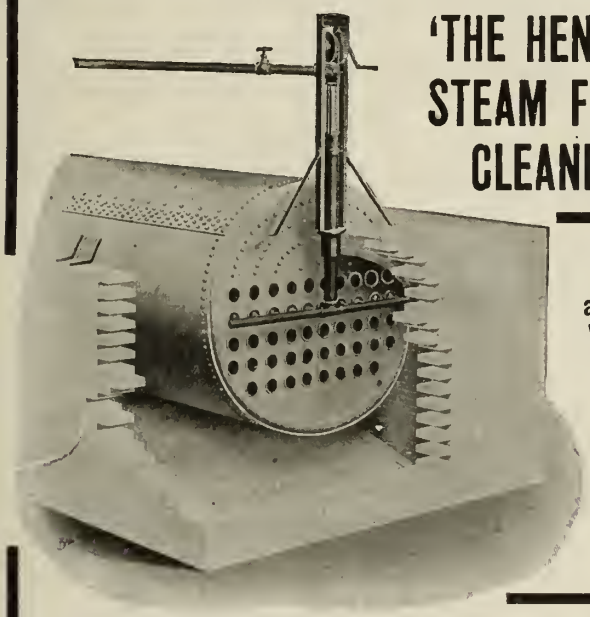


THE MOST RATIONAL — SELF-ACTING BOILER FEED

Direct Boiler Feed is also possible with **one** Return Steam Trap according to the situation.

Dominion Sugar Company, Ltd. We received your favour of the 5th inst. and noted its contents. To our great satisfaction we are able to inform you that your **Return Steam Traps,** are working excellently. We have now installed all **four,** which have worked faultlessly right away from the commencement. — **One** double Return Steam Trap suffices for conveying the condensed water from 6 Sperber drying apparatus directly back to the boilers. — *Since the Return Steam Traps were installed the feed pump for the boilers of the splitting-drying department has not been used.* — **The saving in coals is considerable,** since by aid of the Return Steam Traps we can now easily keep up full steam, **whereas previously we had constantly to force the boilers to the utmost.** After the experience gained with your condensed water Return Steam Traps we must admit, that no plant ought to be without the same. **The feed pump has always been a unisance to us.**
We leave it to your discretion to make whatever use of this you please.
Wallaceburg (Canada), Ont., Novbr. 22 nd, 1909.

'THE HENRY' STEAM FLUE CLEANER



Effects a Saving Wherever Used

This is a mechanical device which, by the use of steam, will thoroughly clean all the flues of a boiler in five minutes, with little labor and while the boiler is in actual use.
It saves fuel, saves labor, increases boiler efficiency.
The only logical way to clean flues. Steam blows **with the draft—not against it.**
Write for full particulars to-day.

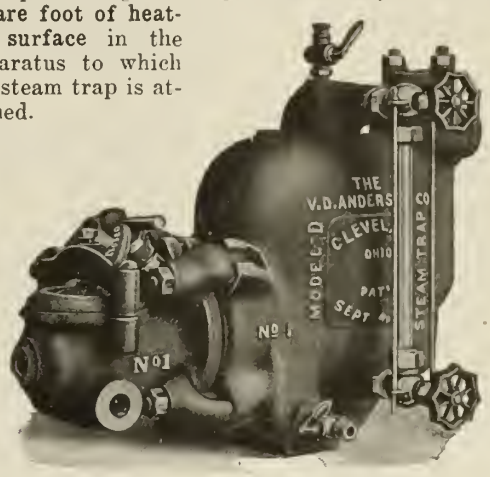
THE STEAM APPLIANCE CO.

MILWAUKEE, WISCONSIN.

Western Agent: **CANADA SALES CO.** Donalda Bldg. Winnipeg.
Eastern Agent: **ENGINEERS REPRESENTATIVE CO.** 201 Board of Trade Bldg. Montreal.

The Anderson Model "D" Steam Trap

Automatically and continuously drains the condensation from radiators, steam coils or heating systems as fast as it accumulates, without reducing the pressure or permitting the escape of live steam, thus permitting the highest efficiency from every square foot of heating surface in the apparatus to which the steam trap is attached.



Cut below illustrates valve and seat. These parts are **accurately machined,** and can be depended on to fit. We carry in stock and are prepared to finish valves and seats that will work at any pressure.

By our system any **trap can be changed from high to low pressure** or vice versa by simply ordering the necessary valves and seat for the pressure desired.

All parts of the Model "D" are interchangeable. The removable perforated strainer, which is part of the equipment, prevents pieces of scale, packing lead, etc., from entering trap.

Let us connect you with users of this trap—get their verdicts as to its efficiency.

Write for full particulars and booklet.

THE V. D. ANDERSON CO.

West 96th. St., CLEVELAND, OHIO

BRANCH OFFICES: 330 Manhattan Building, Chicago, Ill.; 619 Park Bldg., Pittsburg, Pa.; 3 Arch St., Philadelphia, Pa.; 212 Walnut St., Cincinnati, Ohio; 1207 Union Trust Building, Baltimore, Md.; 91 High Street, Boston, Mass.

Pillow Blocks.
Can. Bond Hanger & Coupling Co., Alexandria.
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J. C. Wilson & Co., Glenora, Ont.

Pipe Coils.
National Pipe Bending Co., New Haven, Conn.

Pipe Cutting and Treading Machine and Tools.
Can. Fairbanks-Morse Co., Montreal.
Curtis & Curtis Co., Bridgeport, Conn

Pipe, Steel.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co,. Toronto.
E. Leonard & Sons, London, Ont.

Pipe (Second-Hand).
Imperial Waste & Metal Co., Montreal.

Pipes, Water.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Pacific Coast Pipe Co., Vancouver, B. C.

Piping and Fittings.
Jas. Morrison Brass Mfg. Co., Toronto.

Piping, Steam.
Babcock & Wilcox, Montreal.
Imperial Waste & Metal Co., Montreal.

Planimeters.
H. L. Peiler & Co., Montreal.

Plate Work.
Canada Foundry Co., Ltd., Toronto.
Fraser & Chalmers, Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

Plumbing Machinery.
Chicago Pump Co., Chicago, Ill.

Polish, Metal.
G. W. Hoffman, Indianapolis.

Power Pumps.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
Deming Co., Salem, O.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Goulds Pump Co., Montreal.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.

Power Transmission Machinery.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery & Transmission Co., Elmira, Ont.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Columbus.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Pulleys.
C. O. Bartlett & Snow Co., Montreal
Can. Fairbanks-Morse Co., Montreal.
Crescent Oil Co., Hamilton, Ont.
Elmira Machinery and Transmission Co., Elmira, Ont.
General Supply Co. of Canada, Ottawa
Jeffrey Manufacturing Co., Columbus.
Manitoba Bridge & Iron Works Limited, Winnipeg.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Pulp Mill Machinery.
Escher, Wyss & Co., Toronto.
Jeffrey Manufacturing Co., Columbus.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

Pumping Machinery.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Canada Foundry Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Deming Co., Salem, O.
General Supply Co. of Canada, Ottawa
Standard Eng. Co., Toronto.
Waterous Engine Works Co., Brantford.

Pumping Machinery, Electrical.
Chicago Pump Co., Chicago, Ill.
Jeffrey Manufacturing Co., Columbus.

Pump Governors and Regulators.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
G. M. Davis Regulator Co., Chicago, Ill.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.
Watson & McDaniel Co., Philadelphia.

Pump Strainers.
Canadian Steam Boiler Equipment Co., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.

Pumps, Air.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Canada Foundry Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Deming Co., Salem, O.
General Supply Co. of Canada, Ottawa
E. Leonard & Sons, London, Ont.

Pumps, Centrifugal.
Alberger Condenser Co., New York
A. W. Bennet, Toronto.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Deming Co., Salem, O.
Canadian Boving Co., Toronto.
Escher, Wyss & Co., Toronto.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

Pumps, Geared, Compound.
American Steam Pump Co., Battle Creek, Mich.
Canada Foundry Co., Ltd., Toronto.
Deming Co., Salem, O.
Can. Fairbanks-Morse Co., Montreal.
E. Leonard & Sons, London, Ont.

Pumps, Hydraulic, Pressure.
American Steam Pump Co., Battle Creek, Mich.
Canada Foundry Co., Ltd., Toronto.
The Deming Co., Salem, O.

Pumps, Oil.
The Deming Co., Salem, O.
Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, O.
Manzel Cros. Co., Buffalo, N.Y.
Michigan Lubricator Co., Detroit.

Pumps, Steam.
American Steam Pump Co., Battle Creek, Mich.
Bawdon Machine Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
The Deming Co., Salem, O.
C. A. Dunham Co., Toronto.
General Machinery Co., Toronto.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.

Pumps, Vacuum.
Alberger Condenser Co., New York.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Canadian Steam Boiler Equipment Co. Toronto.
Hare Eng. Co., Toronto.
C. A. Dunham Co., Toronto.

Pump Tank, Receiver.
American Steam Pump Co., Battle Creek, Mich.
Canada Fdry. Co., Ltd., Toronto.

Pyrometers.
Jas. Morrison Brass Mfg. Co., Toronto.

Rails (Relaying).
Imperial Waste & Metal Co., Montreal

Radiator Air Vents.
Jas. Morrison Brass Mfg. Co., Toronto.

Refrigerator Doors, Windows, Etc.
Jones Cold Store Door Co., Hagerstown, Ind.

Refrigerating Engineers.
Chas. Bishop, Montreal.

Refrigeration Machinery.
International Marine Signal Co., Ottawa.
Linde British Refrigeration Co., Montreal.
Linde Can. Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.

Reducing Wheels.
H. L. Peiler & Co., Montreal.

Regulators, Pressure.
C. A. Dunham Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
The Sims Co., Erie, Pa.

Revolving Doors for Hardening Rooms.
Jones Cold Store Door Co., Hagerstown, Md.

Revolution Counters.
Maihak Indicator Agency, Montreal.
Schuchardt & Schutte, Montreal.

Rheostats.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Roofings—Asbestos and Wool Felts.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.

Rope Preservative.
Cling Surface Co., Buffalo.

Rotary Converters.
Can. Fairbanks-Morse Co., Montreal.
Can. Gen. Electric Co., Ltd., Toronto
Can. Westinghouse Co., Hamilton.

Rubber Hose.
Dunlop Tire and Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Canada, Ottawa
Liberty Mfg. Co., Pittsburgh, Pa.
Quaker City Rubber Co., Philadelphia,

Rubber Specialties.
Dunlop Tire & Rubber Goods Co., Toronto.

Safes.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

Safety Valves.
Can. Fairbanks-Morse Co., Montreal.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
H. L. Peiler & Co., Montreal.

Screens.
C. O. Bartlett & Snow Co., Montreal

Shafting.
C. O. Bartlett & Snow Co., Montreal
Elmira Machinery and Transmission Co., Elmira.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
Waterous Engine Wks. Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

Shaking and Dumping Grates.
Babcock & Wilcox, Montreal.
Can. Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
Waterous Engine Wks. Co., Brantford

Smoke Consumers.
Automatic Smoke Prevention Co., Montreal.
Canadian Steam Boiler Equipment Co., Toronto.

Smoke Boxes, Stacks.
Babcock & Wilcox, Montreal.
Canada Fdry. Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
Waterous Engine Wks. Co., Brantford

Smokeless Furnaces.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Wks. ,Detroit, Mich.
Geo. H. Tod, Manning Chambers, Toronto.

Soot Cleaners.
Vulcan Tube Cleaning Systems, Ltd., Montreal.

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Can. Fairbanks-Morse Co., Montreal.
Waterous Engine Wks. Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

Sprocket Chain Attachments.
C. O. Bartlett & Snow Co., Montreal
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
Waterous Engine Wks. Co., Brantford

Spur Wheels.
Can. Fairbanks-Morse Co., Montreal.
Waterous Engine Wks. Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

Stand Pipes, Steel.
Canada Fdry. Co., Ltd., Toronto.

Steam Separators.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.
The Sims Co., Erie, Pa.
Steam Appliance Co., Milwaukee.
Watson & McDaniel Co. Philadelphia

Steam Specialties.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co. Toronto.
H. L. Peiler & Co., Montreal.
Penberthy Injestor Co., Windsor.
The Sims Co., Erie, Pa.
Watson & McDaniel Co. Philadelphia
Vulcan Tube Cleaning System, Ltd., Montreal.

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Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
C. A. Dunham Co., Toronto.
General Supply Co. of Canada, Ottawa
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Can .Morehead Mfg. Co., Woodstock.
H. L. Peiler & Co., Montreal.
Schneider & Helmecke, Madgeburg, Germany.
Steam Appliance Co., Milwaukee, Wis.
Watson & McDaniel Co., Philadelphia

Steam Turbine Blowers.
Hare Eng. Co., Toronto.
Robb Eng. Co., Amherst, N.S.

Steam Turbine Generators.
Hare Eng. Co., Toronto.
Robb Eng. Co., Amherst, N.S.

Steam Turbine Pumps.
Alberger Condensor Co., New York.
Hare Eng. Co., Toronto.
Robb Eng. Co., Amherst, N.S.

Stokers.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Wks., Detroit Mich.
Geo. H. Tod, Manning Chambers, Toronto.

Strainers.
Elliott Co., Pittsburgh, Pa.

Superheaters, Steam.
Babcock & Wilcox, Montreal.

Switchboards, Light and Power.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Devos Electric Switch Co., Montreal.
Hill Electric Switch Co., Montreal.
Monarch Electric Co., St. Lambert, Que.

Switches and Switch Boxes.
Canadian General Electric Co., Limited, Toronto.
Canadian Westinghouse Co., Hamilton.
Devoe Electric Switch Co., Montreal.
Hill Electric Switch Co., Montreal.
Monarch Electric Co., St. Lambert, Que.

Tachographs.
Maihak Indicator Agency, Montreal.

Tachometers.
Maihak Indicator Agency, Montreal.

Tanks, Blow-off.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.

Tank Lugs.
Otterville Mfg. Co., Otterville, Ont.

Tanks, Oil.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Wks. Co., Brantford

Tanks, Rendering.
C. O. Bartlett & Snow Co., Montreal

Tanks, Water.
Canada Foundry Co., Ltd., Toronto.
International Marine Signal Co., Ltd., Ottawa.
Pac. Coast Pipe Co., Vancouver, B.C.

Telephones.
Northern Electric & Mfg. Co., Limited, Montreal.

Transformers.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Monarch Electric Co., St. Lambert, Que.

Transmission Machinery.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery & Transmission Co., Elmira, Ont.
General Supply Co. of Can., Ottawa.
Goldie & McCulloch Co., Galt, Ont.
Jeffrey Manufacturing Co., Columbus.
Waterous Engine Wks. Co. Brantford
J. C. Wilson & Co., Glenora, Ont.

Trucks, Factory.
Can. Fairbanks-Morse Co., Montreal.
General Supply Co. of Canada, Ottawa

Tube Cleaners.
Canada Fdry Co., Ltd., Toronto.
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General Supply Co. of Can., Ottawa.
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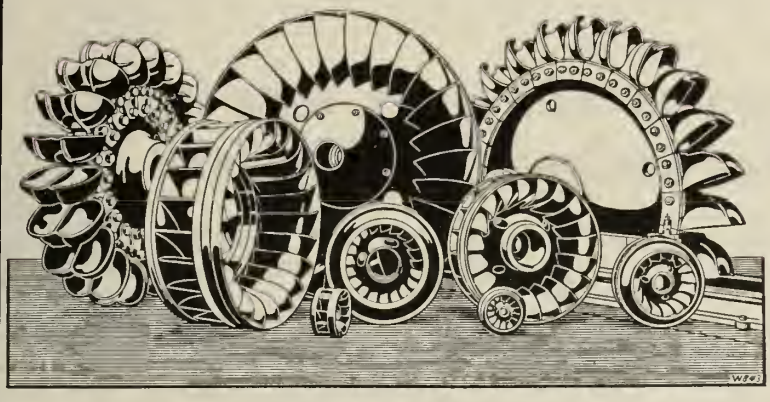

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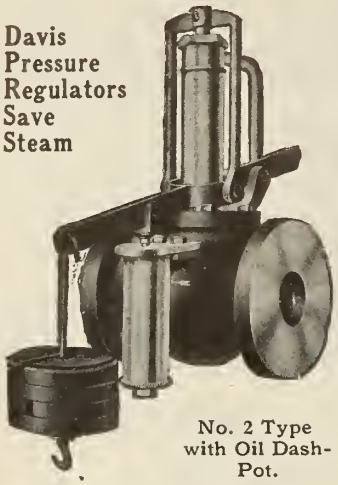

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Boilers must be operated at the highest pressure required—yet some of your engines, pumps, heaters, dryers or cookers will probably operate just as well on a much lower pressure. The Davis Pressure Regulator saves this difference.

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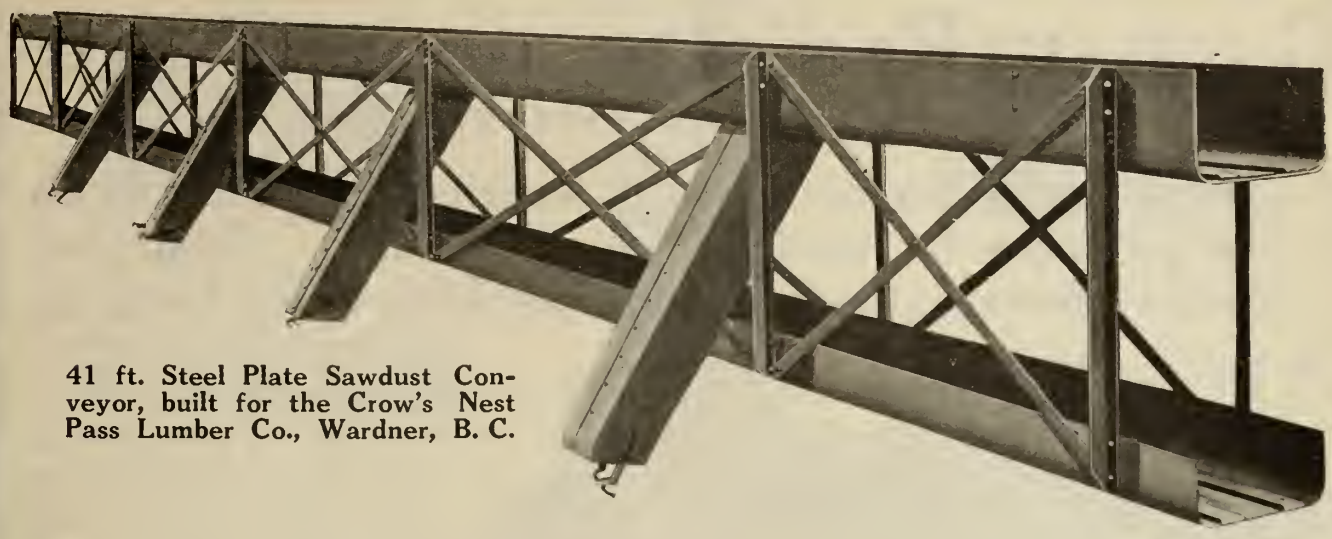

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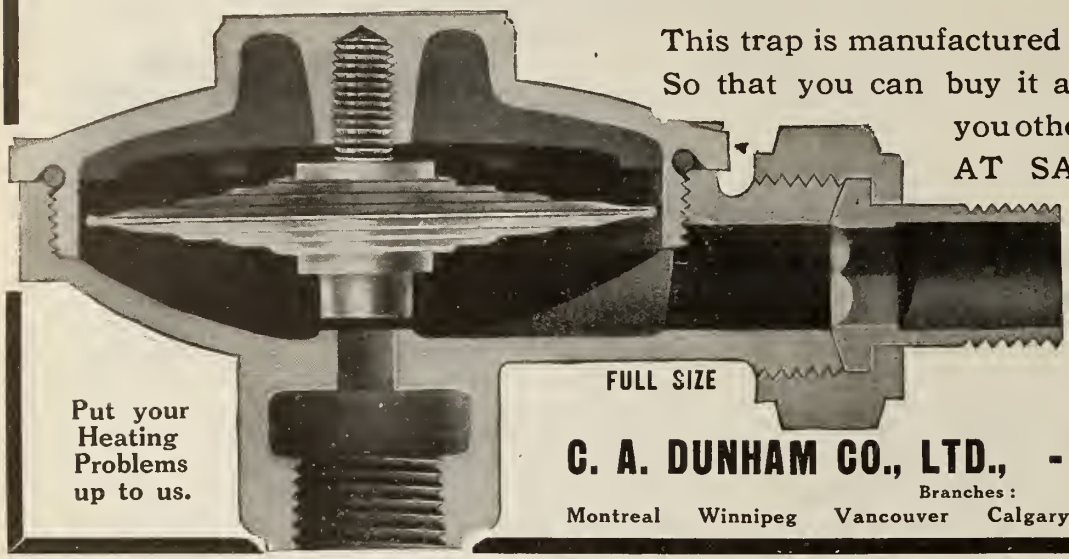

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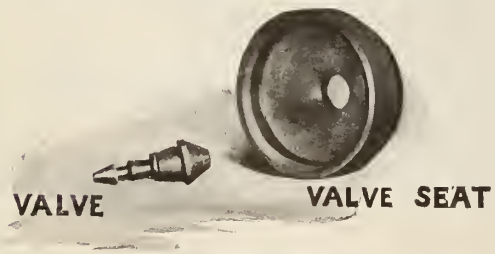

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There are many users of the Model "D" Steam Trap who will be glad to let you profit by their experience. Let us connect you with some of them. Write for names.

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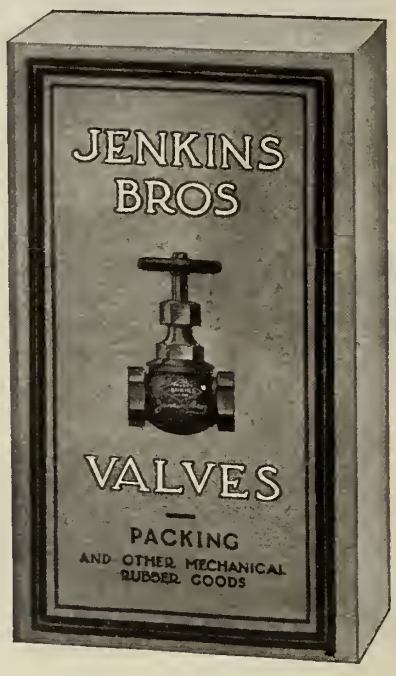
Jenkins Bros.

Catalog for 1912



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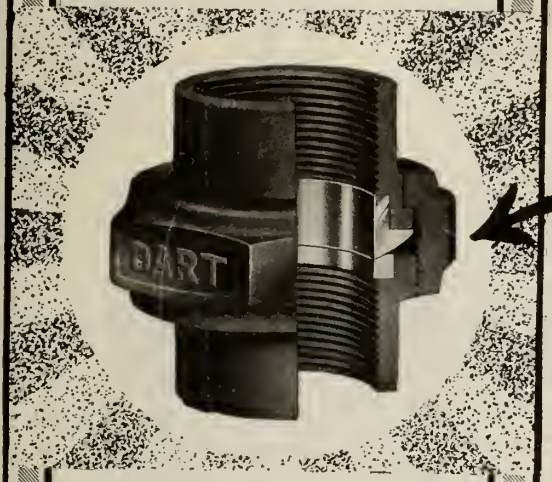

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It is made in screwed, flanged, tee and elbow types, male or female.

Dart Union Co., Limited

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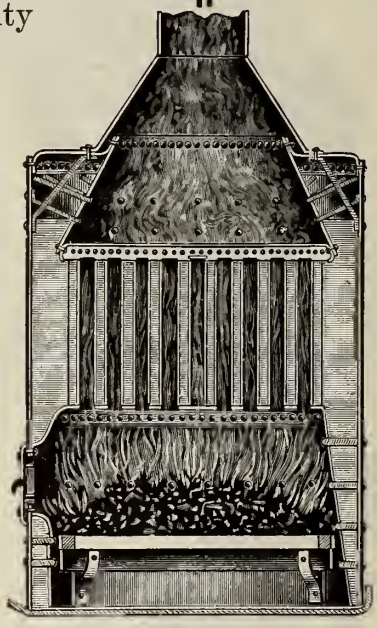
From start to finish these boilers are under the supervision of experts, and are made by men with long experience. Only the best materials are used, so as to ensure a boiler of unusual durability and safety.

It will pay you to communicate with us and get full particulars. You may need a new boiler soon, and you will want the best.



We build various types:

Scotch, Clyde, Fitzgibbon, Vertical, Mosher.

Horizontal Tubular, Vertical, Locomotive Type, "Heine" Water Tube

GENERAL PLATE WORK

POLSON IRON WORKS, LIMITED

STEEL SHIPBUILDERS, ENGINEERS AND BOILERMAKERS

TORONTO **CANADA**

REPRESENTATIVES IN CANADA FOR

The B. F. Sturtevant Co., Hyde Park, Mass., U.S.A., Fans, Blowers, Heating and Ventilating
The John I. Thornycroft Co., London, England, Marine Motors

The advertiser would like to know where you saw his advertisement—tell him.

BETTINGTON BOILERS

How much does it cost you for steam?
How much fuel remains in your ash?
How much unconsumed volatile is going up your stack?
If you are burning slack coal are you obtaining the maximum evaporation from it?

REASONS WHY THE BETTINGTON SYSTEM WILL CUT DOWN YOUR FUEL BILLS.

1. Analysis of the ash shows no carbon.
2. Volatile is all consumed.
3. Cheap coal containing as high as 35% ash can be burned with the highest efficiency.
4. Stand by losses eliminated.
5. The cheapest grades of coal can be used.
6. Less labor required.

Bettington Boilers in course of erection for Dominion Coal Co., Ltd.

OPERATING ADVANTAGES OF THE BETTINGTON SYSTEM.

1. No grates.
2. No fires to clean.
3. Less ash to handle.
4. Fuel supply quickly adjusted to demand for steam.
5. No smoke.
6. No stand by boilers with banked fires necessary to take care of peak loads.
7. Full load can be obtained in 30 minutes from a cold boiler.

THE BETTINGTON SYSTEM of burning pulverized fuel gives all the advantages of gas fired boilers, and 80% thermal efficiency with the cheapest fuel can be continuously obtained.

FRASER & CHALMERS
LIMITED

Canadian Branch:
4 PHILLIPS PLACE, - - MONTREAL, P.Q.

The advertiser would like to know where you saw his advertisement—tell him.

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY

Make Your Winter Evenings Count

An hour or two of an evening, spent in studying our new Valve Book, will make you an expert—both theoretically and practically—on the Slide Valve. This valuable book will cost you nothing, if you send for it at once, before the supply is exhausted.

Positively, the book will not be sent, unless the coupon is completely filled out and returned to us.

How To Get The Valve Book FREE

Fill out the Coupon, and mail it to us. We will address a book to you, and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and look at Daniel's P. P. P. Packing.

Your Name .....
Address .....
Employed by .....
Address .....
Horsepower of Engine .....
Kind of Rod Packing Used .....
Do you use EBONITE Sheet Packing? .....
Dealer's Name .....
Address ..... Series 24 L-V
Name of Buyer .....

If your dealer doesn't carry P. P. P. we will write telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

Get out of the Habit of Sunday Work

If you spend Sundays, packing your engine, it is your own fault—you don't use the right kind of packing.

Thousands of engineers never worry about Sunday work for the reason that their engines are packed with

Daniel's P. P. P. Rod Packing

P. P. P. is the self-setting packing, adjusting itself automatically to the requirements. There is no unnecessary friction. It contains the best of lubricants; cannot become hard, and gives the longest and best service. P. P. P. keeps scored rods steamtight, and makes all rods as smooth as glass. A trial will make you a constant user of P. P. P. Send for a sample showing construction.

FREE to Users of P.P.P.

If you are a user of Daniel's P.P.P., fill out the coupon and mail it to us with the Big Red D—cut from the box lid—and a **testimonial letter** of your experience with the packing. We will mail you a FREE copy of "The Slide Valve" direct. You'll not be required to go to your dealer for the book. Don't forget the letter.

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods
PHILADELPHIA, PA., U.S.A.

In the year that has passed we have made many new friends among mechanical men.

Old friendships, too, have been more strongly cemented and we take this opportunity of expressing our cordial wish that your Christmas may be supremely happy and that you may prosper amazingly during the coming year.

The Garlock Packing Co.

HAMILTON, ONT.

MONTREAL TORONTO WINNIPEG VANCOUVER

Look For This TRADE MARK On The Packings You Buy

By Doing This You Make Certain of Getting the Utmost Service for Your MONEY

DUNLOP

Piston Rod Packing

Before Pressure

Works equally as well on a heavy pump as on the most sensitive valve stems.

It is suitable for all purposes, whether steam, water, ammonia, oils or alkalies.

It is self-lubricating and cannot become hard under any condition.

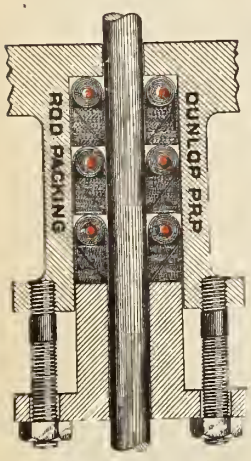
Dunlop Piston Rod Packing expands so as to take up wear from the rod, and reduces friction to a minimum.

This packing has an extremely long life, and, considering this, and the efficient service it gives, it is the best value that you can procure.

When in the market for Packing, Belting, Hose, Valves, etc., consult us. We make a suitable article for every specific purpose. If you purchase our line you will be one of the many who realize that fact.

Our Trade Mark is your protection — always looks for it.

Under Pressure

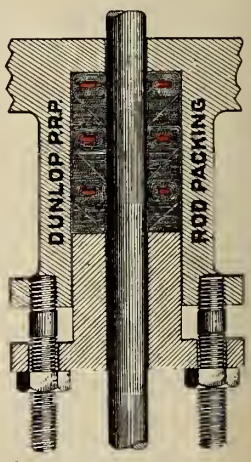


Stuffing Box and Rod with Packing in, and gland adjusted,

Dunlop Tire & Rubber Goods Co., Limited

Head Office and Factories: TORONTO

Branches: Victoria, Vancouver, Nelson, Edmonton, Calgary, Regina, Winnipeg, London, Ont.; Hamilton, Toronto, Ottawa, Montreal, St. John, N.B.



Stuffing Box and Rod showing Packing under Pressure

The advertiser would like to know where you saw his advertisement—tell him.

You Can Dodge a Lot of Trouble Next Year

by using Goetze Elastic Corrugated Copper Gaskets with Asbestos Lining No. 2 in every flanged joint in your plant.

By starting right now to renew with these gaskets, you can steadily reduce your renewals till you've brought them almost to the vanishing point.

That sounds almost too good to be true, but nevertheless it is true. We can prove it by unimpeachable evidence from almost any part of the wide world where steam is used for power.

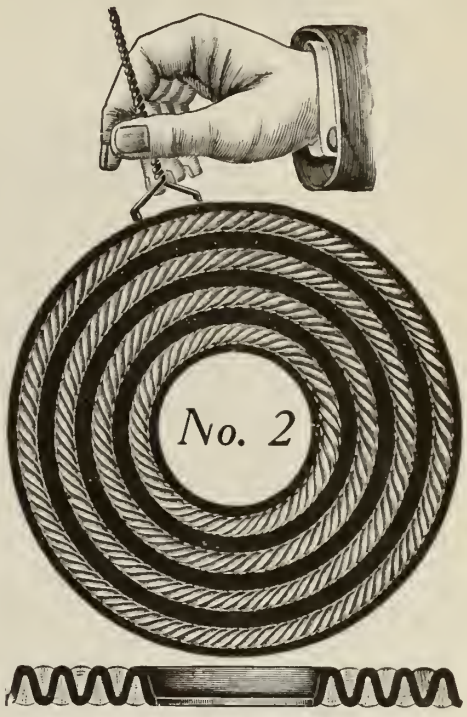
We can prove it in your own plant, and we will, if you say so, by sending you Goetze Gaskets for ninety days' trial on the very joints that have given you the most trouble. If we don't prove it, and to your complete satisfaction, you needn't pay us a cent.

Think what it means to regasket a joint that you've never been able to keep tight for more than a few days or weeks, and know that you can forget that joint for years.

Think what that means in the saving of fuel, of labor, of gasket costs and shut-downs. And think what all these mean when translated into dollars.

And then don't think you'll try them "some day," because there will never be so good a time to begin building bigger profits in 1913 as right now.

Send your trial order (no matter how small) today, for we wish you a Happy and Prosperous New Year, and want to do what we can to help you in that direction.



It will pay you to get acquainted with Goetze No. 2 Efficiency, to learn the difference between an ordinary Gasket and a No. 2 Gasket.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

St. John, N.B.

BRANCHES AT

MONTREAL
70 Cedar Ave.

WINNIPEG
C. E. Chown, 147 Bannatyne Ave.

VANCOUVER
A. O. Campbell, 1069 Hamilton St.

MANUFACTURED BY

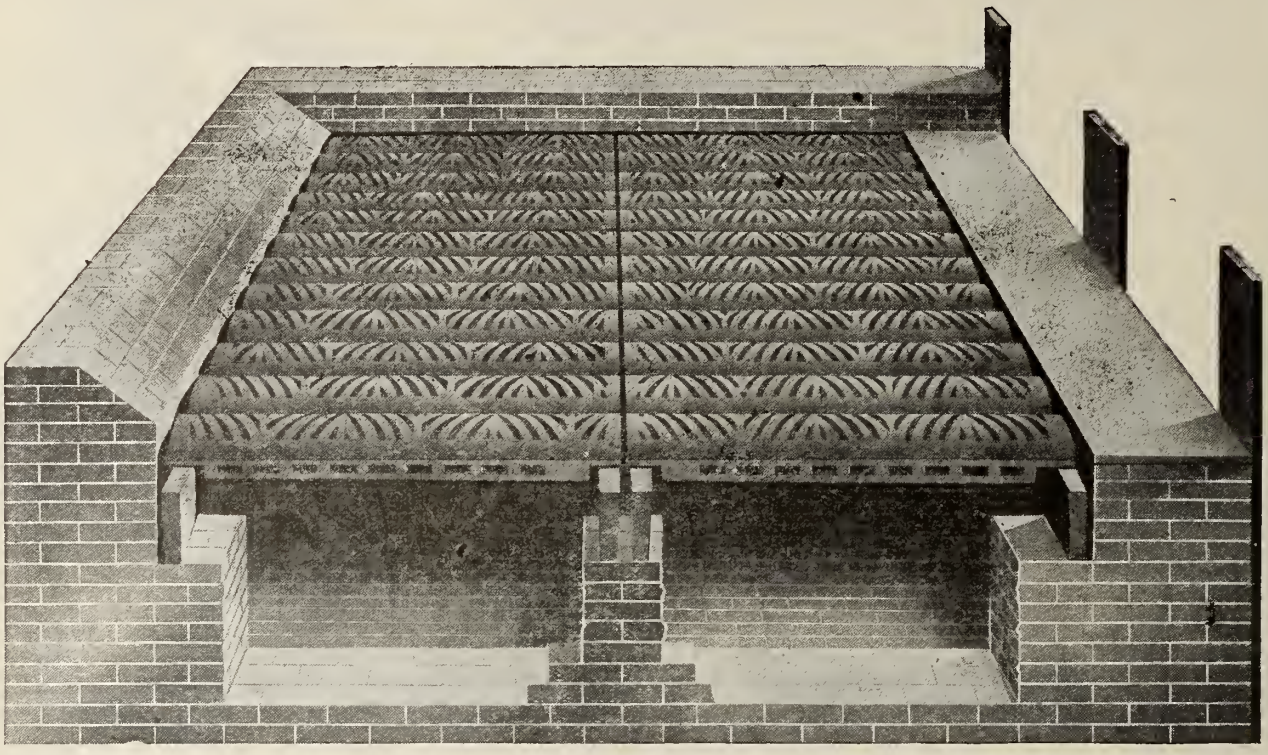
Goetze Gasket & Packing Co.

NEW BRUNSWICK, N.J.

THOMAS ELLIPTIC GRATE BARS

SHAKING—CIRCLE—STATIONARY

FOR EVERY FUEL



THOMAS IDEAS

PATENTED

THOMAS ELLIPTIC GRATE BARS	INCREASE STEAM—SAVE FUEL—SAVE LABOR —COST LESS—REDUCE SMOKE.
THOMAS GRATE RESTS	EVERLASTING—PRESERVE GRATE BARS—PROTECT FIRE WALLS.
THOMAS FURNACE SETTING	FIRE WALLS—BRIDGE WALL—FRONT WALL independent of all expanding and contracting irons. SEE THAT AIR SPACE COMPLETELY ENCIRCLING THE GRATE AREA. No dead and burned grate bar ends. No pushed down walls from expansion of grates.

Shipped from Hamilton, Ont. **Let us give you complete information.**

FOR ALL PROBLEMS

Steam—Grate Bar—Furnace—write THOMAS

The General Supply Co. of Canada, Ltd.

OTTAWA TORONTO WINNIPEG

THOMAS GRATE BAR CO., **Birmingham, Ala., U.S.A.**

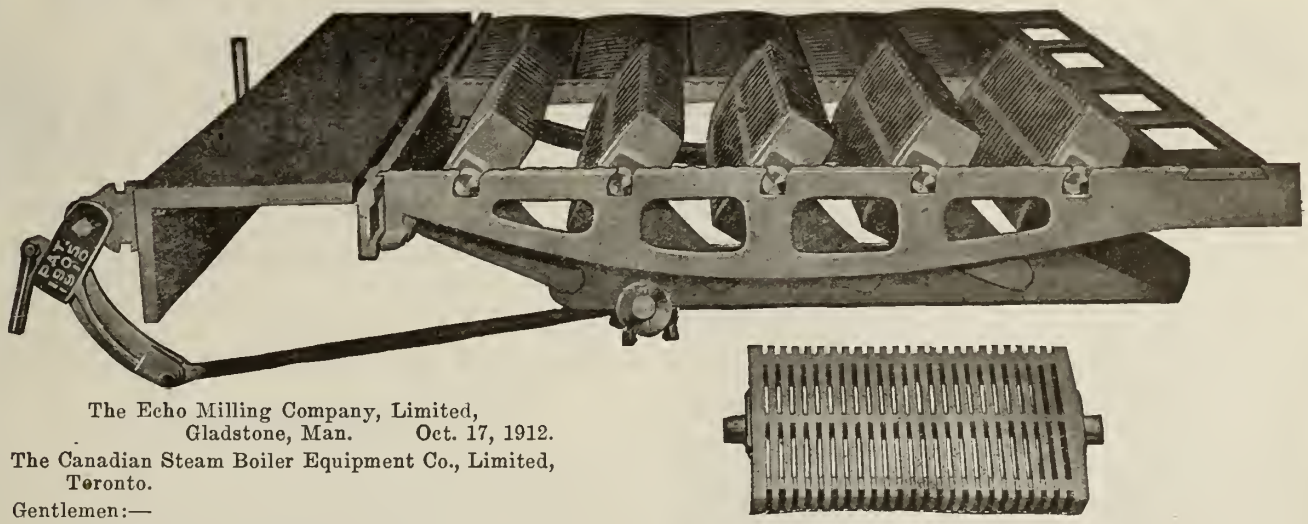
The advertiser would like to know where you saw his advertisement—tell him.

"THE Cyclone"

Shaking and Dumping Grate Bar

Is Built Upon the Plan to Enable the Engineer to Fire Light and Keep His Fires Free from Ash

The Cyclone Grate accomplishes this by its wonderful ability to cut off the ash without dropping unburned fuel through, with the fire doors closed. No grate made is as efficient in this respect as the "Cyclone," and no other grate has so large an air capacity to supply the air necessary to good combustion.



The Echo Milling Company, Limited,
Gladstone, Man. Oct. 17, 1912.

The Canadian Steam Boiler Equipment Co., Limited,
Toronto.

Gentlemen:—

Enclosed please find cheque to cover invoice for two sets of Cyclone Grates. We were late in getting started up, but have had them in use 2 weeks, and are satisfied that they are all you claim for them. Kindly receipt account and return.

Yours truly, Echo Milling Co., Ltd.

The Echo Milling Company, Limited,
Gladstone, Man. Oct. 28, 1912.

The Canadian Steam Boiler Equipment Co., Limited,
Toronto.

Gentlemen:—

We have yours of the 21st, and in reply would say that we have no objection to you using ours of the 17th, as a testimonial, if you think it will do you any good.

We shall only be too glad to give your grate bar a good word with any intending buyer, as our engineer says the only fault he has to find that we did not put them in sooner. We are yours truly,

Echo Milling Co., Ltd.

Read This!

Don't Buy an Imitation ---Get the Genuine

There are imitators who claim that their grates are as good as the "Cyclone." If any of them pay you a visit ask them to prove it—they can't.

CANADIAN STEAM BOILER EQUIPMENT COMPANY, Ltd.

SOLE MANUFACTURERS FOR CANADA

211 QUEEN STREET EAST :-: :-: :-: **TORONTO, CANADA**

AGENTS

ST. JOHN, N.B., F. W. Blizard, Canada Permanent Chambers. MONTREAL, H. L. Peiler & Co., 308 St. James Street.
HAMILTON, Robt. Fitzsimmons, 8 Grove Street. CALGARY, Alta., The Western Foundry & Metal Co., Limited.
BERLIN, J. Hainsworth, 14 Foundry Street. WINNIPEG, Vulcan Iron Works.

Ventilating a Valuable Fact

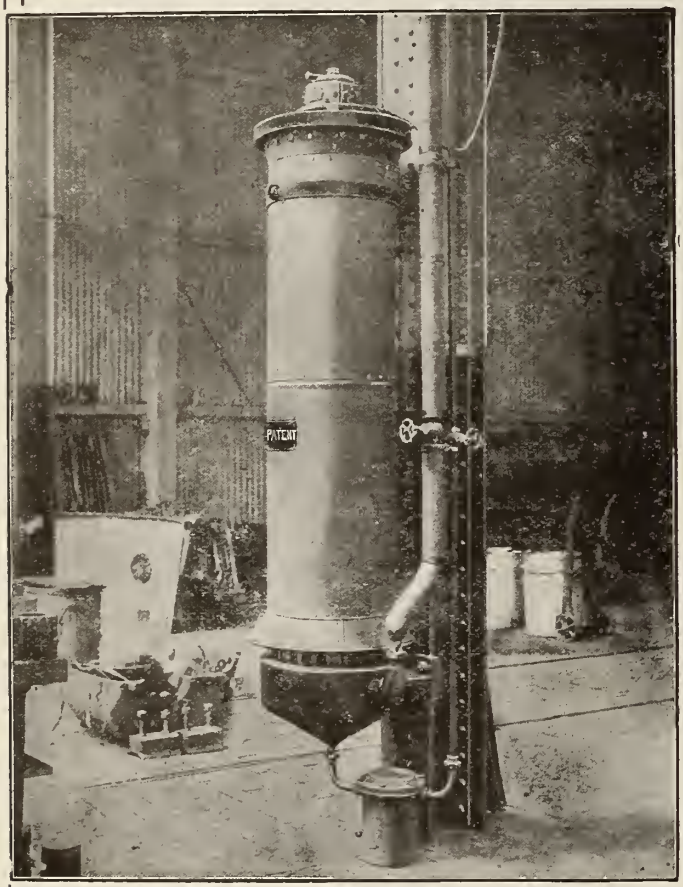
A Subject of Vital Importance to Your Business

It is a well established fact that a man working in a properly heated and ventilated shop can accomplish far more than the same man working in a poorly heated and ventilated shop. He can do more, and do it better, and stands a bigger chance of doing it day in and day out.

THE STANLOCK SYSTEM

of Heating and Ventilating

Inexpensive at the start and completely satisfactory in use. Adopted by many leading engineers and big manufacturers in this country and Europe.



The System

This system consists of units as shown below. They are made of steel tubes screwed into circular cast iron bases and through these tubes steam passes. Enclosing these tubes is a sheet metal cylindrical casting with a motor at the top. The air is forced downwards, thus keeping the floor warm. A special pipe can be fitted, passing through the roof or through the side wall, thus giving a supply of fresh air. Dampers are provided so that the inside air can be circulated or outside air can be taken in and heated. Can be installed in old or new buildings.

Its Advantages

1. No overhead air ducts are required.
2. No underground masonry ducts are required.
3. No obstruction to light due to overhead air ducts.
4. No heat losses due to radiation from air ducts.
5. Minimum of power absorbed.
6. Units hung on walls. No floor space needed.
7. Various units operated independently and can be turned on or off like radiators. Some supply fresh heated air and others merely circulate and heat.
8. A unit using 60 lb. steam pressure heats 3,600 sq. ft. of floor space.
9. The first cost of apparatus is very low.
10. Units may be added at any time in case of extensions, and in case of boiler shops, units may be removed entirely during the summer months, if desirable.

IT WILL PAY YOU TO ASK US FOR COMPLETE INFORMATION AND AN ESTIMATE ON YOUR REQUIREMENTS. DICTATE A LETTER TO-DAY

THE GARTH COMPANY

Sole Canadian Agents

26-32 Craig Street, Montreal

You Can Make No Mistake

In Using in Your Boiler

POTATO SCALE POWDER BOILER COMPOUND

Guaranteed to give entire satisfaction or not to be paid for.

THOUSANDS ARE USING IT

We have no Dissatisfied Customers

It Will Save You a of lot Money

IT WILL ABSOLUTELY RID YOUR BOILERS OF ALL SCALE OR DIRT

C. C. SNOWDON

Sole Distributor for Potato Scale Powder for the Dominion of Canada and the United States.

Refiner and Manufacturer
Boiler Compounds, Oils, Grease, Etc,

CALGARY, ALTA.

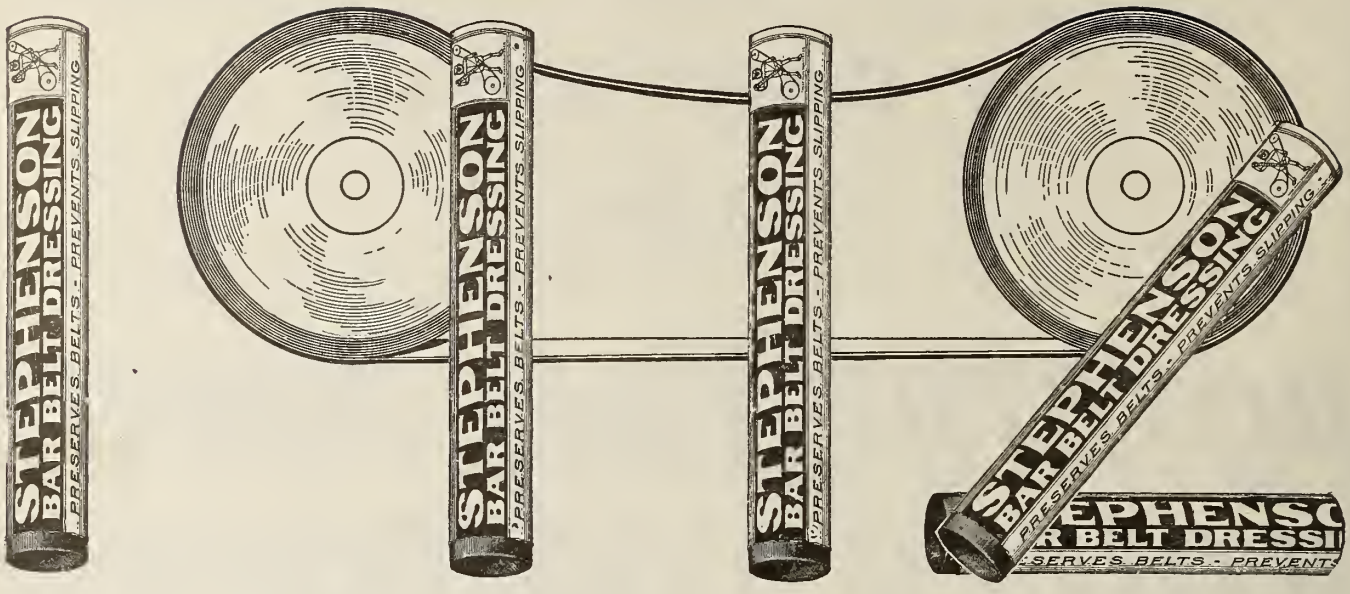
IT GIVES SATISFACTION EVERYWHERE

Wanted at once, a First-class Agent in

MONTREAL, TORONTO and HALIFAX

The advertiser would like to know where you saw his advertisement—tell him.

For



Use Stephenson Bar Belt Dressing

Make 1913 a record breaking year. Turn over a new leaf and get rid of the things that have been causing needless trouble and expense. Adopt the things which will make your work easier, give better results and save money for your employer. You cannot start at a better place than with your belt dressing.

Get rid of your troublesome liquid dressing. Shake the can for the Stephenson solid stick and shake trouble at the same time.

Stephenson Bar Belt Dressing is a friend in need. It doesn't require preparation, nor do you have to use special care in applying it. The minute the belt slips you hold the Stephenson bar to the belt for a few seconds and the slipping stops. There's no waste—no slop—no smearing on of paste or pouring on of spattering liquid. And the results are better.

I'll "Stick to the Solid Stick"

Start With a Free ½ Lb. Sample

Simply send us your name and address and we'll send you a present in the shape of a free half-pound sample of Stephenson Bar Belt Dressing.

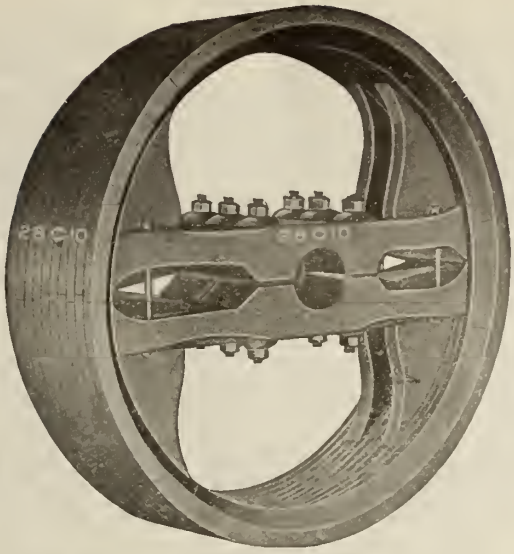
Remember—we give you this sample absolutely free of charge. Get this free half-pound of the finest belt dressing made and test it. Here's your chance to try somesomething really good at no expense.

None Genuine Without Trade-Mark

Stephenson Manufacturing Company

Est. 1888 **Albany, N.Y.** **Inc. 1897**

The advertiser would like to know where you saw his advertisement—tell him.



For Power Transmission

Use Fairbanks

Wood Split Pulleys

These Pulleys are the result of years of experience in the manufacture of Wood Pulleys. They embody many excellent features and are conceded to be in every mechanical detail, the most perfect Wood Pulley made.

The arms are made of birch in varying numbers of sections according to the width of the pulley, and are clamped to the shaft by through bolts.

A special feature of construction which makes these pulleys the peer of all others and overcomes the inherent objection to Wood Pulleys, i.e., the separating of the rim from the arms, is the web. This web is mortised into the arms and rim, securely holding the whole pulley together.

The Rims and also the Webs are made of thoroughly seasoned bass wood, as it will transmit 25 to 60 per cent. more power than any other. The Rim is built up in segments or "lags" about 6 inches long. Every layer breaks joints with the preceding layer and each segment is nailed to the others by triple coated nails. These nails are triple coated to prevent them from pulling out and as a protection against dampness, oil, etc.

Each pulley is covered with several coats of special water-proof varnish, which forms an excellent surface for the belt.

These pulleys are bored to a standard and have a complete system of interchangeable Wood Bushings, one set of bushings furnished with each pulley.

ASK FOR CATALOG No. 17

The CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

SCALES, VALVES, GAS ENGINES, PUMPS, RAILWAY AND CONTRACTORS' SUPPLIES, ETC.

Montreal, St. John, Ottawa, Toronto, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

SAVE 50%

By Using
GREASE AS A LUBRICANT
In The

"PHILADELPHIA" GREASE CUP

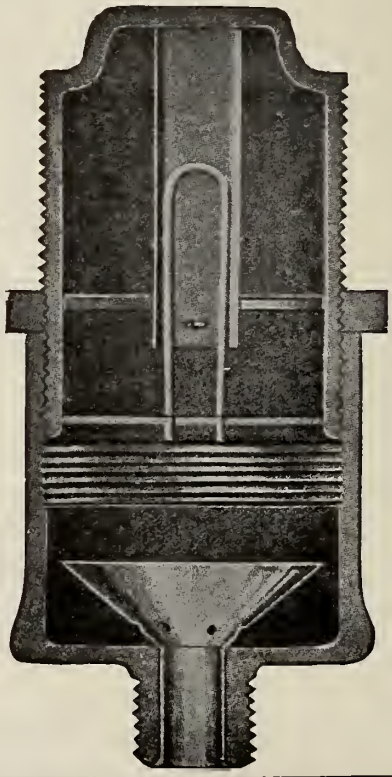
Automatic Feed Under Compressed Air
Slow And Continuous
No Oil Drips—Reduced Fire Hazard

Unexcelled for Lubricating Loose Pulleys, Crank Pins and all classes of Extremely High Speed and Heavy Running Machinery.

In the "Philadelphia" Grease Cup System of lubricating there is no friction, no piston or spring is used, just a thin metal disc resting lightly on the grease to keep it level.

Air pressure above and the needs of the journal below are all that is required to give perfect lubrication. Grease does not change in the slightest, while in the "**Philadelphia**" **Cup**; the last drop is as good as the first.

There is a large unrestricted outlet and a regularity of action which permits feeding of grease of any thickness.



We guarantee a saving of at least 50% over any other system. You must be perfectly satisfied before you pay a cent.

Our Booklet tells more about it — write to-day.

Peterborough Lubricator Mfg. Co., Limited

PETERBOROUGH, ONTARIO

A NEW WRINKLE IN PISTON PACKING

Magnolia Metal Co.,
113-115 Bank St., New York, N.Y.

Shortsville, N.Y., July 10th, 1912.

Gentlemen:—

Your letter received some time ago regarding my experience with Magnolia Metal would have been answered before, but I was giving your metal a new test.

I have used it on crank pins, main bearings, guides of engines, also bearings of motors and high speed fans, where other metals failed to hold. I had one 36 in. Fan that had to be rebabbitted nearly every day. After putting Magnolia in, it held over a year; held until the oiler neglected to keep plenty of oil in oilwell, which was no fault of the metal. It was on this Fan that I first learned of the value of Magnolia.

But the test I now wish to speak of is a Piston Packing for which I found that Magnolia proved a great success on a 180 H.P. Engine at 90 R.P.M., carrying a load of 250 I.H.P. I could not keep any packing in stuffing box on piston that would hold over three or four days, so concluded to try Magnolia. Here is my method: I take the metal, place it in a milling machine, mill up fine, then prepare cloth sacks, fill with fine metal, wrap them around the piston, screw up gland and put engine to work. Piston will blow back two or three days and then stop, and you will then have a perfect metallic Packing. I found that the pressure will drive metal together which will wear for years. I have found that this never fails on bad rods where no packing will hold. I never tried this before on an overloaded Engine, but on Engines carrying the rate of power, but this engine that I have just treated is 180 H.P. Corliss, doing 250 I.H.P., and it has proved O.K., as it always has before.

You may use this letter if you wish, or I shall be pleased to aid anyone by my experience in using Magnolia, for I know its worth, as I have used it in some hard places, and always found it true to wear without trouble where other metals failed.

I always keep Magnolia on hand, and would not be without it.

Yours very truly,

F. N. TITUS, Engineer,
Shortsville Wheel Works,
Shortsville, N.Y.

SPECIAL OFFER.

PRACTICAL ENGINEER POCKET BOOK: 700 pages, over 2000 subjects. Price 40c. post paid. We import these books, in large numbers, from England, as an advertising medium and give Engineers the benefit of low price. They are highly spoken of.

Address Montreal Office.

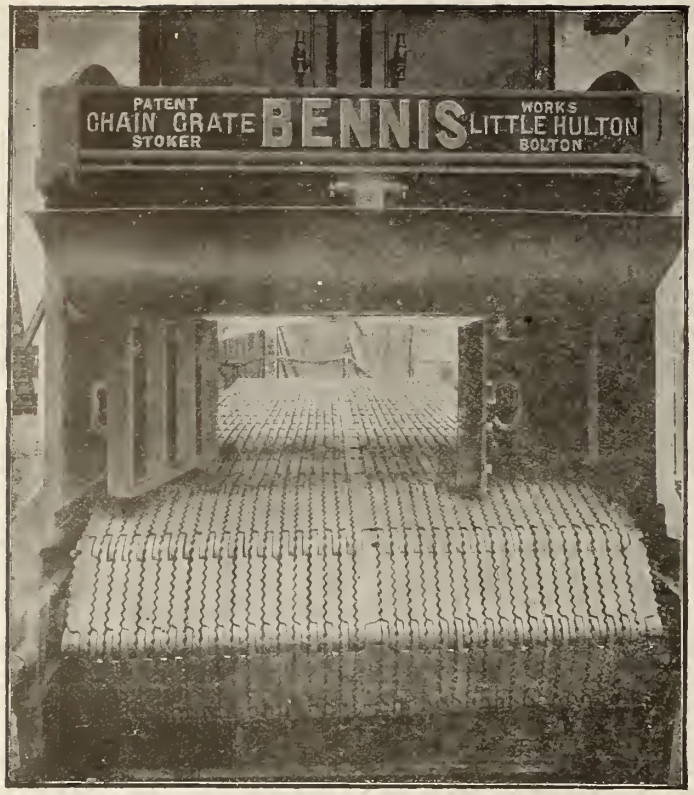
Sold by leading Dealers everywhere or by

Magnolia Metal Co.

OFFICE AND FACTORY:

225 St. Ambroise St. MONTREAL

The advertiser would like to know where you saw his advertisement—tell him.



BENNIS CHAIN GRATE STOKER

More air space is provided to each square foot of grate area than with other makes, and without additional widening of the **actual** air spaces.

The continuous surface of the grate ensures economy in the length of the grate.

By means of the continuous drive, smoothness of running is assured.

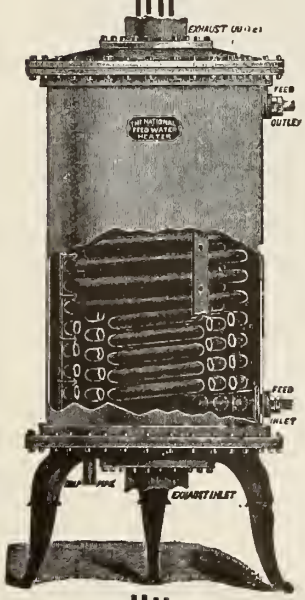
The speed of the stoker can be adjusted to a nicety, as there are six variations.

The stoker can be easily hand-fired in case of emergency.

Fine slack fuels can be satisfactorily burnt.

Write for "Boiler House Economy" Pamphlets, and Full Particulars to

GEO. H. TOD 213 Manning Chambers Queen Street West **TORONTO**



It's easier to fire the boiler if a National Feed Water Heater is on the line.

You don't have to use so much coal, for part of the heating is done by the exhaust steam.

You don't have to handle so much ash and clinker.

The boiler stays in good condition much longer for there's less wear and tear with hot feed water.

The heater will cause you no trouble for it's free from complications.

The National

has *coils*—not straight tubes—the coils take care of expansion and contraction—no leaks to look out for.

Has many coils so that the feed water is heated quickly and economically.

Let us send you our Catalogue.

National Pipe Bending Co.

91 Lloyd Street **New Haven, Conn.**

46-9

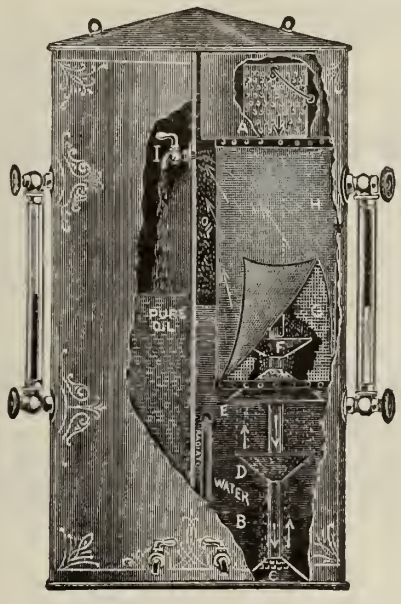
The advertiser would like to know where you saw his advertisement—tell him.

You Can Save 65%

Or More of Your Oil

Through the use of

The "SIMS" OIL FILTER



The quality of Oil is not impaired by its use—it simply cannot be used again on account of foreign matter it has taken up passing through the bearings.

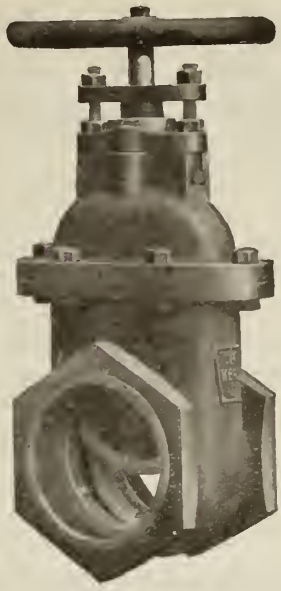
The "SIMS" Oil Filter removes these impurities.

This Filter is made of the best grade of galvanized sheet iron, double-lapped joints, riveted, well braced and soldered. It has a partition through the centre, which separates the clean oil section from that used for filtration. The clean oil is not disturbed when the filtering section is being cleaned; for continuous oiling systems this arrangement is very effective.

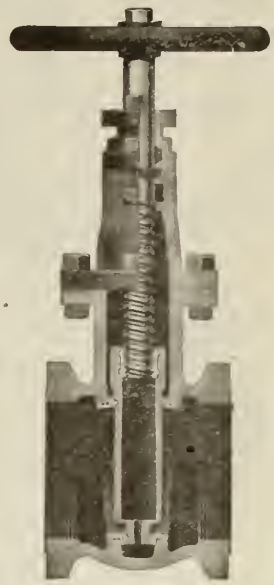
If interested in saving Oil write us at once for dscription and price.

THE SIMS COMPANY
Erie, Pa.

CANADIAN REPRESENTATIVES:
H. L. Peiler & Co., 380 St. James Street, Montreal, Que., and 69 Adelaide Street West, Toronto, Ont.



6 inch Screwed Iron Body Gate Valve



6 inch Interior View of I. B. B. M. Gate Valve

KERR
IRON BODY
GATE VALVES

The above illustrations are of the new **"KEYSTONE"** pattern gate valve which we are now shipping to our customers, and which is being so favorably commented upon by all who have as yet seen them, owing to their modern equipment and strong compact design.

See that

KERR

is on the body of the next valves you buy.

Specify them, and you'll get them.

The Kerr Engine Co.
LIMITED

WALKERVILLE - - ONTARIO

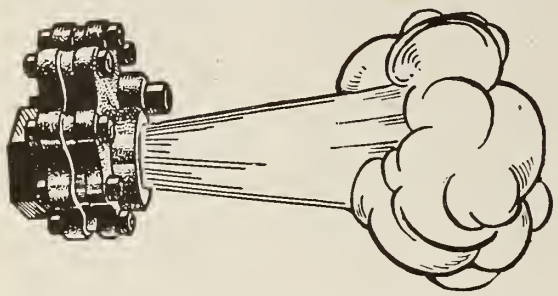
The advertiser would like to know where you saw his advertisement—tell him.

INVESTIGATION

OF "EVERLASTING" BLOW-OFF VALVES

Will Prove Many Facts

IT NEVER LEAKS!



MADE IN MANY TYPES FOR

Stationary
Locomotive
Marine
Ammonia
Gas and Air

WHY NOT INVESTIGATE?

SOLD AND MANUFACTURED UNDER CANADIAN PATENTS BY

Engineering Specialties Company, 1080 King St., West, TORONTO

AGENTS

MONTREAL, QUE.
H. L. Peiler & Co.

ST. JOHN, N.B.
The A. R. Williams Mach. Co.

WINNIPEG, MAN.
The A. R. Williams Mach. Co.

CALGARY, ALTA.
P. D. McLaren Limited

VANCOUVER, B.C.
Taylor-Forbes Company, Limited

Power House Equipment

IF YOU WANT TO

Buy, Sell or Exchange

CONSULT US ON

Railway or **Stationary Motors**, Direct or Alternating Current.

Generators or **Generating Units, Engines, Boilers, Pumps, Feed Water Heaters, Condensors, Air Compressors, Booster Sets, Motor Generator Sets, Rotary Converters, Transformers, Switch Boards,** and all sorts of **Manufacturing Machinery.**

If you have not received **your** copy of our September bulletin, listing 275 items of **Electrical** and **Manufacturing Machinery**, a post card request will bring it to you by the first possible mail. If you contemplate installing additional equipment or replacing overloaded apparatus, it will pay you to consult us.

Railway Equipment Company of Toronto, Limited

1240-1250 Dundas Street, TORONTO, ONT.

The advertiser would like to know where you saw his advertisement—tell him.

No Service too Severe for J-M Kearsarge Jointless Gaskets

Being constructed of pure, long-fibred Asbestos, J-M Kearsarge Jointless Gaskets are absolutely unaffected by heat at any degree. Fine brass wires are twisted in each strand, giving them such great strength that they will withstand a pressure of 250 pounds without blowing out. They do not contain a particle of vegetable fibre or hemp, so cannot char, disintegrate or harden.

Of special importance is the fact that handholes, manholes, flange joints, etc., may be broken down half a dozen times and the same J-M Kearsarge Jointless Gasket used over again, thus outlasting many ordinary gaskets.

J-M Kearsarge Tube Plate Gasket

Write Nearest Branch for sample and Booklet.

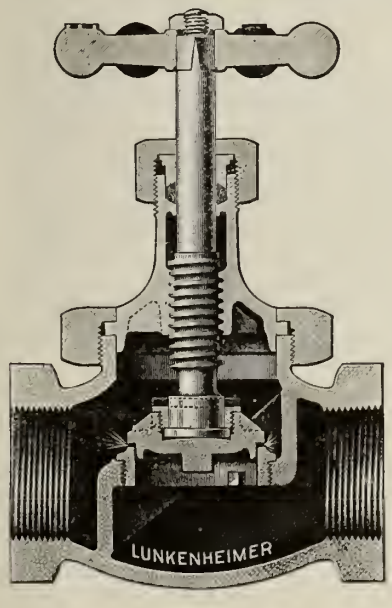
THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED

Manufacturers of Asbestos and Magnesia Products — TRADE ASBESTOS MARK — Asbestos Roofings, Packings, Electrical Supplies, Etc.

TORONTO MONTREAL WINNIPEG VANCOUVER

1194

LUNKENHEIMER "RENEWO" VALVES



When you buy a **Lunkenheimer "Renewo" Valve** you get a valve as perfect as modern science and ingenuity can produce, coupled with the careful selection of the best of only new material and the employment of men skilled in the manufacture of engineering appliances.

The "Renewo" is a valve of **exceptional durability,** made so not only because of the **high grade material used,** but also owing to the **scientific construction of the seat and disc,** which parts are subjected to the greatest wear. Their peculiar construction **greatly minimizes the wear on the seating faces** (caused by the velocity of steam flowing through the valve) and **positively prevents any scale or dirt lodging on these faces** when the disc is about to seat, thereby preventing injury to them.

To further insure durability, **both the seat and disc are made of a most durable nickel alloy,** a material best suited for the hard service to which these parts are subjected.

A slight wear on the seating faces can be easily remedied by regrinding—a process that can be quickly accomplished without detaching the valve, and one that will make the valve as tight and as serviceable as when first installed.

The last but most important feature of **Lunkenheimer "Renewo" Valves,** as regards durability, is the fact that **all parts subjected to wear are renewable,** and this particularly includes the **seat and disc,** and when renewing any of these parts, it is not necessary to break the pipe connections.

The body and trimmings, with the exception of the seat and disc, are made of the highest grade of bronze composition, containing a large percentage of copper and tin, and to insure a uniform mixture, **only new material is used.**

Lunkenheimer "Renewo" Valves are made in sizes ranging from ¼ to 3 inches, inclusive, and in two weights: Medium, for working pressures up to 200 pounds, and Extra Heavy, for 300 pounds.

"MOST supply houses sell them—yours CAN—if they DONT or WONT—tell **US.**"

Write for 1912 catalogue.

THE LUNKENHEIMER COMPANY

1-42

Largest Manufacturers of High-Grade Engineering Specialties in the World.
General Offices and Works: CINCINNATI, OHIO, U. S. A.

NEW YORK, 64-68 Fulton St. — CHICAGO, 186 N. Dearborn St. — BOSTON, 138 High St. — LONDON, S.E., 35 Great Dover St.

The advertiser would like to know where you saw his advertisement—tell him.

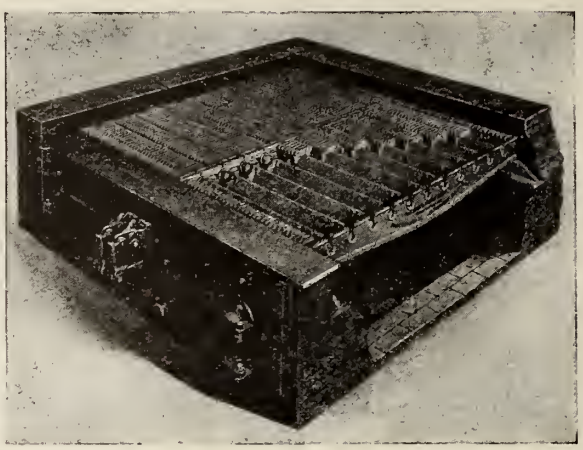
MACDONALD SHAKING GRATE

Send for Booklet

"Them as Has, Gits---"

and

Bulletin No. 4



Removable Tops reduce repair expense, in case a small part becomes burned out.

Points penetrate twice as far as other types with same motion of lever. Locking Device prevents tops being left to burn off.

Made by International Engineering Works, Limited

Owners of Works formerly of

ROBB ENGINEERING COMPANY

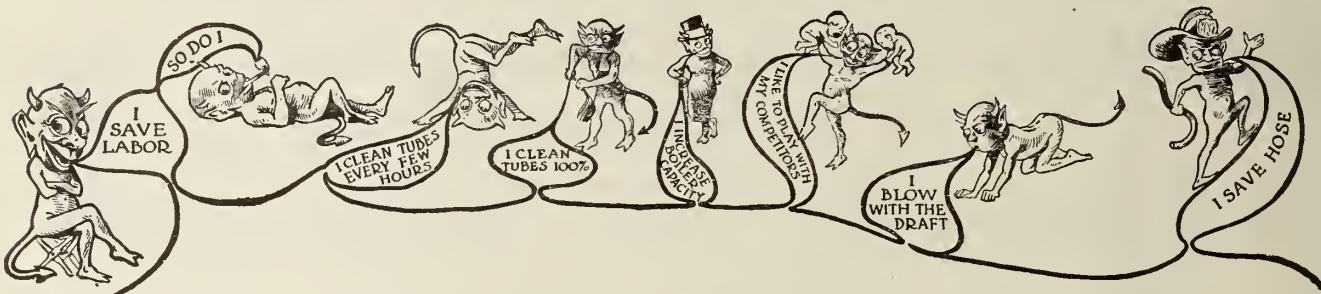
AMHERST, N.S., CANADA — SOUTH FRAMINGHAM, MASS.

SOLE CANADIAN AGENTS FOR
C. A. PARSONS & COMPANY, Newcastle-on-Tyne
Turbines, Turbo-Electric Generators, Turbo Pumps
Blowers and Compressors.

39-22

DISTRICT OFFICES:
Canadian Express Bldg., Montreal, R. W Robb, Manager
Traders Bank Bldg., Toronto, Wm. McKay - "
Union Bank Bldg., Winnipeg, Wm. F. Porter, "
Grain Exchange Bldg., Calgary, J. F. Porter - "

THE VULCAN IMPS


I SAVE LABOR
SO DO I
I CLEAN TUBES EVERY FEW HOURS
I CLEAN TUBES 100%
I INCREASE BOILER CAPACITY
I LIKE TO PLAY WITH MY COMPETITORS
I BLOW WITH THE DRAFT
I SAVE HOSE

"And We All Save Coal"

Wherever the **VULCAN SOOT CLEANER IMPS** are allowed to work they raise the Devil—the Soot Devil. They juggle the heat units and make two units grow where one unit grew before. They make slow steaming boilers "pop" for the first time in years. They give many a weary engineer and fireman a chance to rest. The IMPS are always on the job, "they work while you sleep." They cut out lost time, trouble and repairs. They are good for the operating man and mighty good for the boiler owner. Don't let Soot, the expense maker, worry you longer. Fill out the coupon, mail it now, and we'll send you our Free Booklet, "Economical Steam Production," which shows how the Vulcan removes Soot, and saves from 5 to 15% in fuel.

Mail the Coupon

Vulcan Tube Cleaning Systems,
LIMITED

42 Craig St. West — **MONTREAL**

SIGN, TEAR OUT AND MAIL

P.H. 10-12. Date.....

VULCAN TUBE CLEANING SYSTEMS, LIMITED, Montreal.

Please send me, without charge, your book—ECONOMICAL STEAM PRODUCTION, and your proposition.

(It is important that following information be given in full.)
WATER TUBE BOILERS. Number.....Type.....
Pressure .....Horsepower .....No. Tubes H
(except on Stirling boiler .....Any Superheaters .....Width of alley space at side .....
TUBULAR BOILERS. Number.....Horizontal or Vertical .....
Name .....
Address .....

The advertiser would like to know where you saw his advertisement—tell him.

Repeat Orders are Positive Proof of Merit in the

Murphy Automatic Smokeless Furnace

and Satisfaction on the part of Users

In November issue of Power House we gave you experiences of users — 28 years and down. "There's more to follow."

17 YEARS' EXPERIENCE
DETROIT UNITED RAILWAYS ..... Detroit, Mich.
1895-1912—8 orders—44 furnaces, 11,800 HP.

15 YEARS' EXPERIENCE
MICHIGAN ALKALI CO. ..... Wyandotte, Mich.
1897-1912—11 orders—98 furnaces, 19,665 HP.

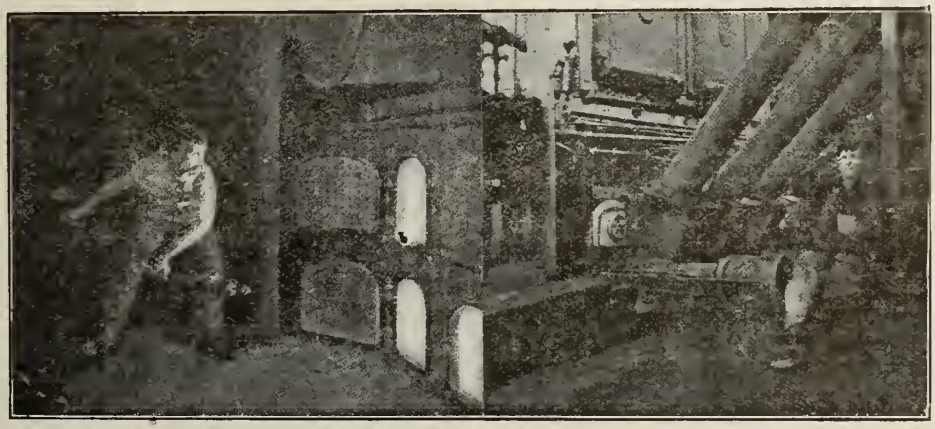
15 YEARS' EXPERIENCE
PITTSBURG RAILWAYS CO. ..... Pittsburg, Pa.
1897-1912—15 orders—96 furnaces, 22,400 HP.

15 YEARS' EXPERIENCE
LARKIN SOAP WORKS ..... Buffalo, N.Y.
1897-1912—9 orders—17 furnaces, 8,740 HP.

14 YEARS' EXPERIENCE
ARMOUR & CO. (Meat Packing) ..... Chicago, Ill.
1898-1912—3 orders—32 furnaces, 12,100 HP.
ARMOUR GRAIN CO. ..... 4 furnaces, 1,000 HP.

Write to-day—for list of Canadian users. THERE MUST BE A REASON—FOR REPEAT ORDERS.

MURPHY IRON WORKS, DETROIT, MICH. BUFFALO, N. Y.



The "hand-fired" method **The Jones Stoker method**

The Jones STOKER

has other advantages besides **saving labour** in the boiler-room!

THE JONES STOKER abates smoke by **PREVENTING** its formation!
THE JONES STOKER is without grates, consequently does not lose the fine coal through grate bars—nothing but incombustible clinker leaves the fire!
THE JONES STOKER increases the boiler horse-power developed, by its unlimited capacity to feed coal and simultaneously introduce the extra air required in the proper proportion for the combustion of same!
THE JONES STOKER maintains a constant steam pressure because of the automatic control of the **air supply** and the **coal supply** by the steam pressure itself!
THE JONES STOKER immediately responds to fluctuating loads and sudden demands for steam!
THE JONES STOKER preserves the heating surfaces of the boiler free from soot deposits due to perfect combustion!
THE JONES STOKER cost for maintenance is low, because there are no moving parts in contact with the fire!
THE JONES STOKER in a small plant makes smoke abatement just as effectual, economy just as much a consideration relatively as in a large one.

Jones Underfeed Stoker Co., Limited National Trust Bldg. TORONTO

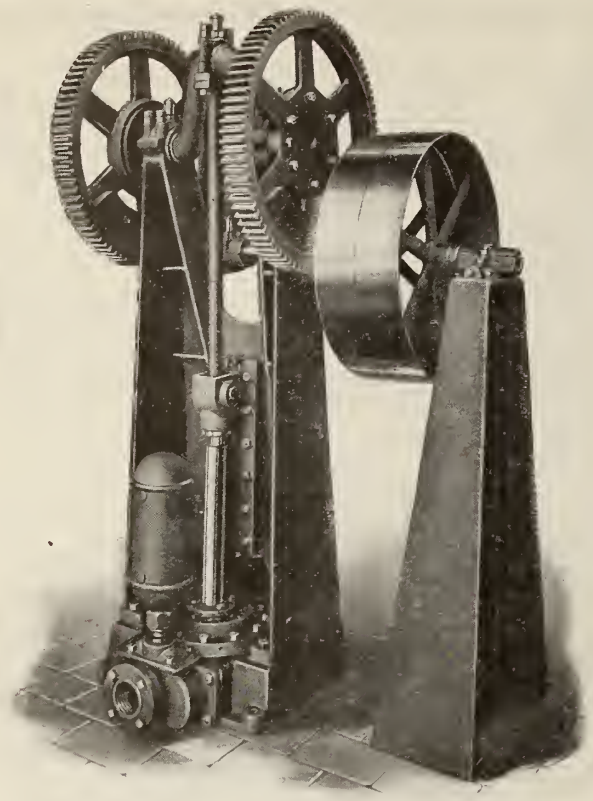


Fig. 82, with 24 in. stroke. Designed for the operation of deep well cylinders. Fitted with double crank gears. Operated by any power. Made in several sizes.

DEMING POWER PUMPS

AND DEEP WELL WORKING HEADS

Recently we sent out a letter to our power pump customers asking what their experience had been with Deming Pumps. One of the most significant developments of this procedure, was the surprise expressed in almost every letter, at the low cost of repairs.

In many cases the outfits have been running day and night for several years, without one repair having been made.

If you are interested in lowering your pumping costs we would like to hear from you.

The Deming Company

SALEM, OHIO

HAND AND POWER PUMPS FOR ALL USES

AGENCIES:

Henion & Hubbell, Chicago.
Darling Bros., Montreal, P.Q.
Root, Neal & Co., Buffalo, N.Y.
Other general agencies in all principal cities.

Marsh Steam Pump

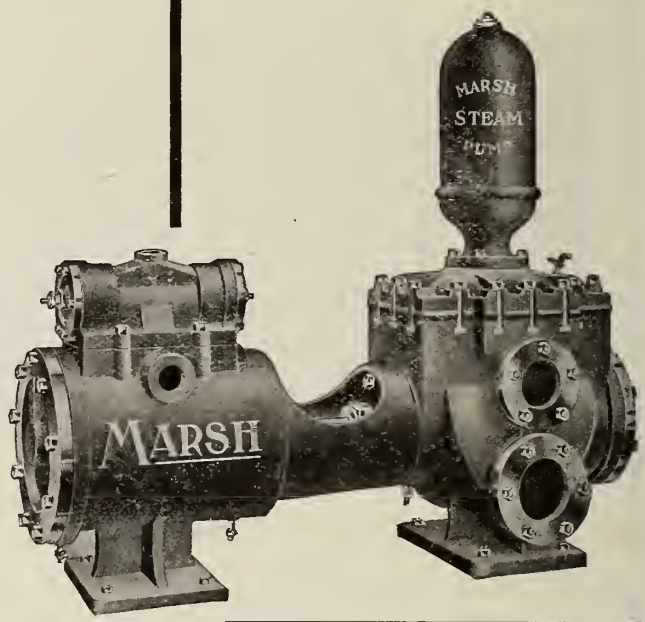
The Pump with the Self-governing Steam Valve

Note the extreme simplicity in construction and the absence of outside valve motion. There is practically nothing to get out of order. Nearly all the wearing parts are made of phosphor bronze instead of common brass, including piston rod, water cylinder lining and valve seats.

The steam valve is self-governing and admits only just enough steam to do the required work. The pump cannot short-stroke, race or pound under the most severe conditions.

115,000 in successful operation.

Ask for Catalog No. 18



American Steam Pump Company

BATTLE CREEK - - - MICH.

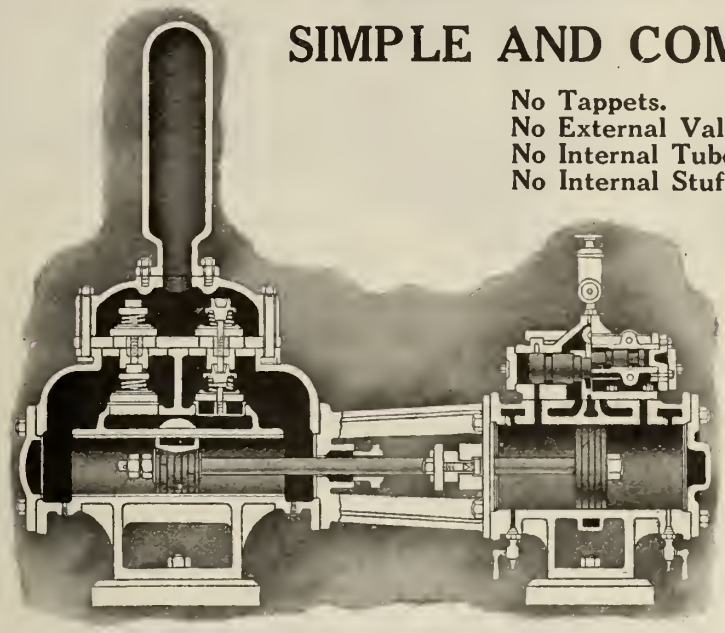
CANADIAN AGENTS

A. R. Williams Machinery Co., Toronto
Williams & Wilson, Montreal
London Engines Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg
Hallman Machinery Co , Vancouver, B. C.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancey & Grindley, Limited
Edmonton & Calgary

"BAWDEN" STEAM PUMPS

MANUFACTURED UNDER ATTWOOD'S PATENTS

SIMPLE AND COMPOUND, For all Purposes



No Tappets.
No External Valve Gear, Levers or Springs.
No Internal Tubes.
No Internal Stuffing Glands.

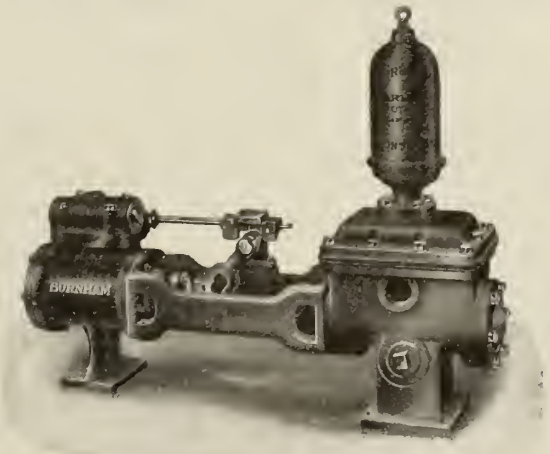
"Bawden" Pumps are governed by piston valves which are controlled by the action of live steam only.
—Simplicity throughout.
—Guaranteed to make full stroke under constant or varying loads.
—Valves, latest improved steam balanced type.
—Greatest economy of steam consumption.
The Bawden Pump provides the simplest, most economical and reliable means for feeding high or low pressure boilers.
Flexibility of speed obtained without any mechanical adjustment.
Automatic cushioning of piston and valves ensures greatest safety in any emergency.

THE BAWDEN MACHINE CO., Ltd., Toronto, Can.

BURNHAM STEAM PUMP

Of the thousands of steam pumps installed every year, a large percentage of them bear the name of "Burnham," the **Steam Pump** endorsed by leading Architects, Consulting Engineers and Heating Contractors as the best, simplest and most economical pump on the market.

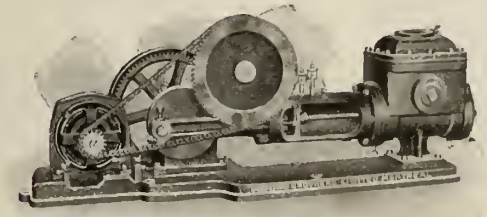
If you want a pump for handling hot water, use the "Burnham."



Burnham Boiler Feed Pump.

Thousands of Burnham pumps are in operation in connection with **Vacuum Heating Systems**; they are specially adapted for this service. Standard Burnham Boiler Feed Pumps and Burnham Vacuum Pumps are kept in stock and can be shipped promptly.

Ask for Catalogue "P."

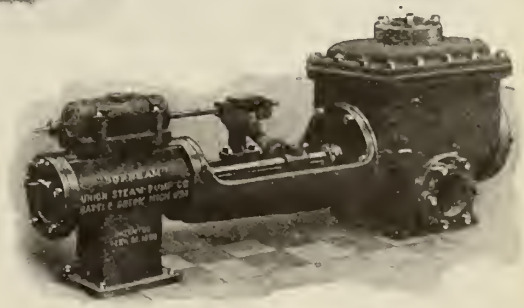


Union Electrically Driven Vacuum Pump.

Darling Brothers,
LIMITED

15 Ottawa St., Montreal.

Toronto, Winnipeg and St. John.



Burnham Vacuum Pump.

SPECIAL WORKS FOR STEAM TRAPS

Established 1878 Exportation

Speciality:

SCREW-VALVE STEAM TRAPS.

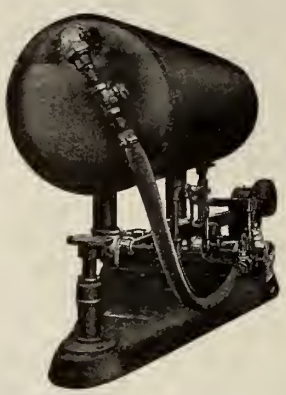
RETURN STEAM TRAPS
for Feeding Back Hot Condensed Water direct to Boiler,
— Without Pump. —

EQUILIBRATED FLOAT-VALVES.

AUTOMATIC WATER ESCAPE VALVE
for Draining the Cylinders of Steam Engines.

GRAPHITE OIL LUBRICATING PRESS
About 70% of Oil saved!

DUPLEX-DRAFT INDICATOR
for Boiler-Furnace.



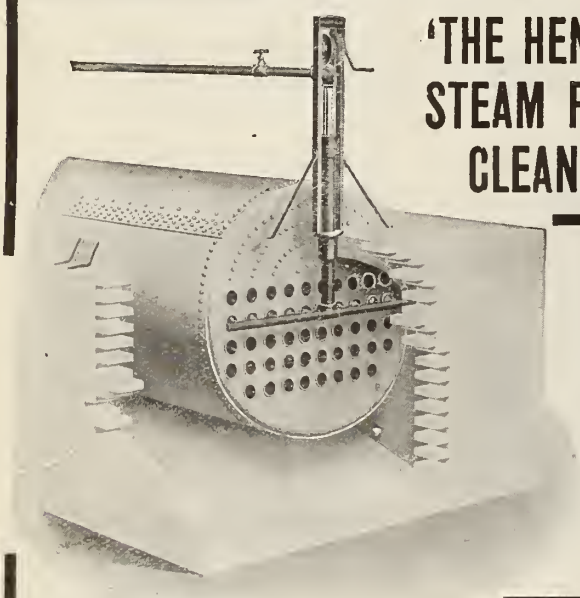
The **Morehead Condenser Trap makes its own Vacuum**

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars and a Trial Trap.

Canadian Morehead Mfg. Co.
WOODSTOCK, ONT.



'THE HENRY' STEAM FLUE CLEANER

Effects a Saving Wherever Used

This is a mechanical device which, by the use of steam, will thoroughly clean all the flues of a boiler in five minutes, with little labor and while the boiler is in actual use.
It saves fuel, saves labor, increases boiler efficiency.
The only logical way to clean flues. Steam blows with the **draft—not against it.**
Write for full particulars to-day.

THE STEAM APPLIANCE CO.
MILWAUKEE, WISCONSIN.

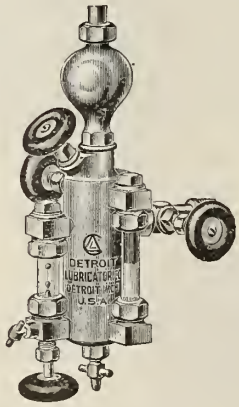
Western Agent: **CANADA SALES CO.** Donalda Bldg. Winnipeg.

Eastern Agent: **ENGINEERS REPRESENTATIVE CO.** 201 Board of Trade Bldg. Montreal.

New Detroit Catalog

The big, new 232 page Detroit catalogue is complete in every way.

It shows a full line of lubricators for every condition met with on every kind of steam engine, steam pump, air compressor, ammonia cylinder. It fully illustrates and describes Detroit locomotive lubricators and specialties, mechanical force feed oilers for gas engines, hand pumps, glass oilers, brass oilers, grease cups, ground key work, water gauges, fusible plugs and other boiler trimmings, valves, and a multitude of other devices.



It shows repair parts for all Detroit Lubricators, gives complete instructions for their installation, care and operation, and contains valuable information on the general subject of lubrication.

This book will help you with your work

If you would like to know more about lubricators and lubrication, this book should contain the information you want. If it doesn't our Engineering Service Department will be glad to help you.

Write for catalogue G-58.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
Windsor, Ont.

A GOOD RULE--

USE THE RELIABLE

HIGH GRADE BABBITT METALS

SOLD ON MERIT.

The Goods are the best, the Prices are right, and every pound is fully guaranteed.

We commend to you the following Brands of our Babbitt, as the best MONEY can buy:

EAGLE GENUINE — METALLIC PACKING
COPPER TOUGH — BETA "COPPERIZED"
SPECIAL HARD — MAPLE LEAF

We can supply you with ANY DESIGN OF BABBITT METAL in the market at SURPRISINGLY LOW PRICES.

GIVE US A TRIAL. YOU WILL BE PLEASED.

PRICES and a VALUABLE Descriptive Catalogue on REQUEST. All Prices named F.O.B. your station.

The DOMINION METAL COMPANY
N. B. Prichard, Engineer and Manager
SHERBROOKE, P. Q.

GRAPHITOL

Pat. and Trade Mark Reg'd.

The graphite cement bearing material.
Another step in the ladder of progress.
A distinct advance over babbitt metals.
The most frictionless material yet produced.
A thorough success.

Write for free illustrated pamphlet describing this material, to

British Pacific Supply Company
F. C. Winkler, Manager,
VICTORIA, B. C.

MAKERS OF GRAPHITOL.

THE MANZEL

AUTOMATIC FORCE AND SIGHT FEED

Oil Pump

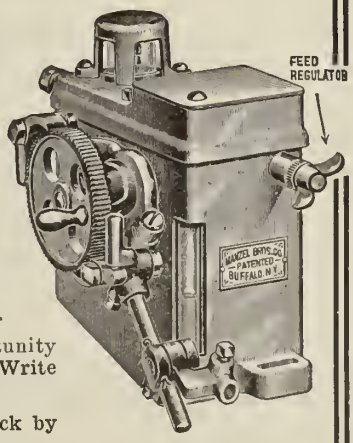
Is Guaranteed to Save 30% of Your Oil

This Oil Pump gives positive lubrication, and feeds regularly, regardless of steam pressure, temperature, speed of engine, or any kind of oil used.

It will cost you nothing to try it.

We will send the Manzel Oil Pump to you on a **Thirty days' trial.** If it does not save 30% of your oil return it at our expense.

Don't overlook this opportunity to try our oil-saving pump. Write us **NOW.**



Complete line carried in stock by

THE TWIN CITY OIL COMPANY
General Agents for Canada
BERLIN - ONTARIO
Manzel Brothers Company, Buffalo, N. Y.

HOMESTEAD
STRAIGHTWAY VALVES

ALWAYS OUTLAST
OTHER VALVES

For Pressure Up to
5000 lbs. per. Sq. In.

The reason is very evident.

Where the common Globe and Gate Valves have their vital parts—the seats—exposed to pressure and constant wear, every minute they are open, the seat of the Homestead Straightway is never exposed.

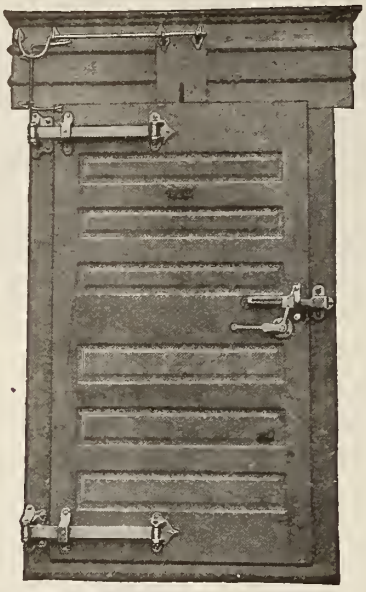
The plug is balanced and held in place by the pressure when open, and when closed it is locked in the seat by our patent wedging cam, insuring freedom from friction in the seat while the plug is turning and making the Homestead the quickest acting, the simplest, the most easily operated and the most durable valve known.

Let us send full details. Write

Homestead Valve Mfg. Co.
PITTSBURG, PA.

The advertiser would like to know where you saw his advertisement—tell him.

J. V. Jamison, President. T. B. South, Vice-President. J. V. Jamison, Jr., Treasurer.



This "Ad" is addressed to users of

Refrigerator Doors, Windows and Ice Chutes
in Canada

for Cold Storage, Meat, Fish, Dairy, Poultry, Fruit and Vegetable products.

We guarantee our Doors not to sag or stick in the frames.

Our Hardware weighs 60 lbs. to set.

We manufacture or sell nothing else.

Our entire time and forces are directed to this line.

We supply

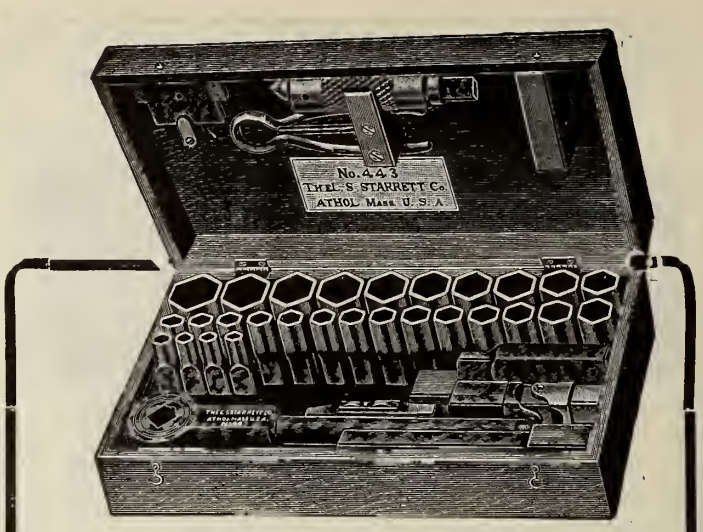
Linde British Refrigeration Co.
Linde Canadian Refrigeration Co. of Canada.
Armour & Co., Chicago, Ill., U.S.
Swift & Co., Chicago, Ill., U.S.

with all they use. Our latest orders are to Swift & Co., for Toronto, Can., 30 Doors; Canadian Fish and Cold Storage Co., Prince Rupert, B.C., 110 Doors.

Send for Catalogue

Jones Cold Store Door Co.

HAGERSTOWN, MARYLAND, U.S.A.



You're never cornered with a

Starrett Patent Ratchet Wrench

It will turn any standard nut or bolt in all sorts of difficult places—places where the ordinary monkey wrench is useless. The ratchet permits rapid action with only a short arc swing. The extension reaches into otherwise inaccessible places. The drilling attachment furnished with the wrench takes any twist drill from ⅛ in. to ½ in. A reversible screw driver makes it handy for turning screws of various sizes, too.

Send for Catalog No. 19 CD

THE L. S. STARRETT CO. **Athol, Mass.**
42-59

Machine Banded Wood Stave

WATERPIPES and TANKS

For city and town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc. One-half the cost of Iron Pipe—and better.

Pacific Coast Pipe Co., Limited

P.O. Box 563 **Vancouver, B.C**

WRITE FOR CATALOGUE

Full Particulars and Estimates Furnished

The advertiser would like to know where you saw his advertisement—tell him.

THE
CANADIAN CASUALTY
AND
BOILER INSURANCE
COMPANY

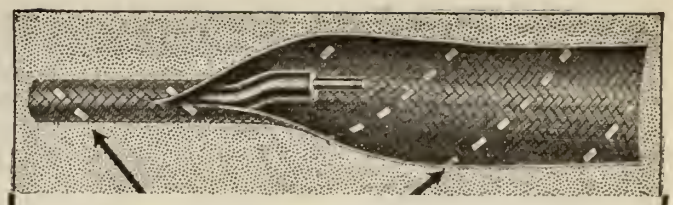
ATTENTION:

In what condition have you left your heating boiler? we would like the privilege to inspect it, and report to you what has to be done before the next heating season.

CONTINENTAL LIFE BUILDING
TORONTO

J. O. B. Latour, Chief Engineer.
John J. Durance, Manager.

Phone Main 6941



Look for this

thread or strand in *green*, woven into the braid of the N. E. C. Rubber Insulated Wire you buy. (A little scraping of the braid will disclose it.) It is a registered

"Sterling" Mark

and your guarantee of *quality*, *economy* and *safety*, based on over thirty years of service. Our booklet "STERLING" is a valuable guide to economical wire buying.

Send for it *now*.

Standard Underground Cable Co. of Canada, Ltd.

Department B. **Hamilton, Ont.**

Manufacturers of Electric Wires and Cables of all kinds, all sizes, for all services, also Cable Terminals and Junction Boxes.

Conduits—Boxes—Fittings

The lines listed below have an unchallenged record for durability and dependability. By their use you are assured of the best possible results.

THOMAS & BETTS—
Conduit Boxes, Galvanized and Japanned
Locknuts and Bushings
Flexible Conduit Fittings
Fixture Studs, Solid and Hickey.

CONDUITS COMPANY—
Rigid Iron Conduit, "Galvaduct" and "Loricated."

CROUSE-HINDS COMPANY—
Condulets, Galvanized and Enamelled.

Large stocks of the above are carried at each Distributing House.
Ask for Bulletin No. 2069.

THE Northern Electric AND MANUFACTURING CO. LIMITED

Manufacturer and Distributor of Telephone Apparatus, Electrical Supplies and Fire Alarm Apparatus for every possible need.

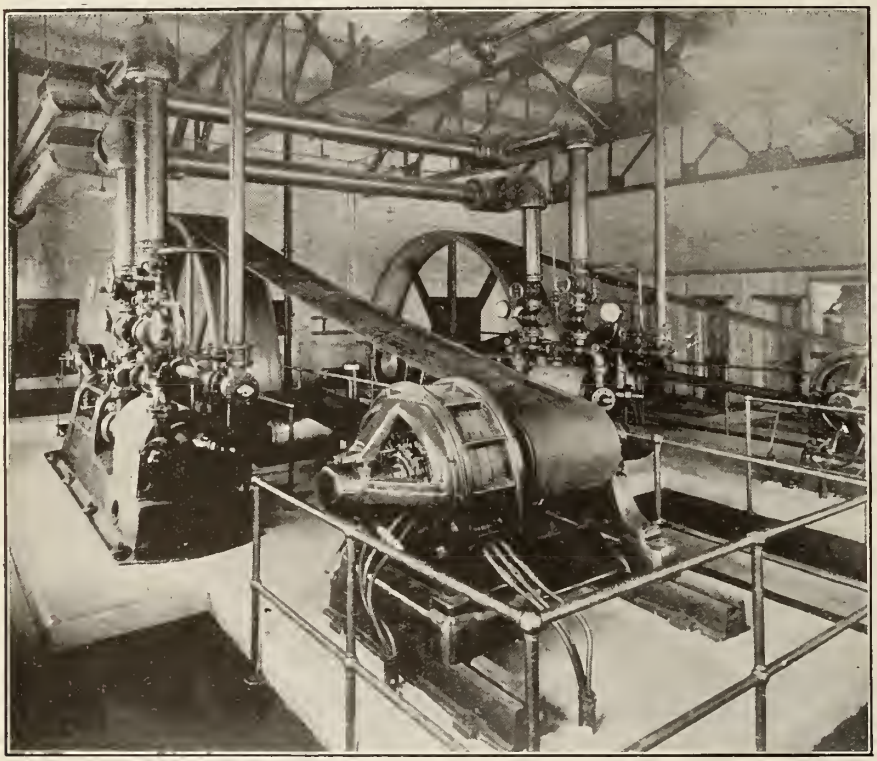
Montreal Halifax Toronto Winnipeg Regina Calgary Edmonton Vancouver

"THE LINDE"

REFRIGERATING and ICE-MAKING MACHINERY

CORK INSULATION

Over 8,000 Machines in use. Established and Manufacturing in Canada for 16 years.



Two 100-ton "Linde" Belt Driven, Double Acting, Horizontal Ammonia Compressors Manufactured and Installed by us in Canada.

Recent Orders:—

IMPERIAL BREWING CO. (3 orders), Kamloops, B.C.

WM. CLARK, LTD., Montreal, Que.

MR. J. A. PATRICK, New Westminster, B.C.

C.P.R. VANCOUVER HOTEL, Vancouver, B.C.

MATTHEWS-LAING, LTD., Fort William, Ont.

CARSON'S HYGIENIC DAIRY CO., Winnipeg, Man.

ST. THOMAS PACKING CO., St. Thomas, Ont.

MONTREAL GENERAL HOSPITAL, Montreal, P.Q.

OTTAWA UNIVERSITY, Ottawa, Ont.

WM. DAVIES CO., Winnipeg, Man.

CANADIAN NATIONAL EXHIBITION, Toronto, Ont.

McGILL UNIVERSITY, Montreal, P.Q.

G. T. P. FORT GARRY HOTEL, Winnipeg, Man.

C. P. R. ALGONQUIN HOTEL, St. Andrews, N.B.

AND MANY OTHERS.

The Linde Canadian Refrigeration Co., Limited

37 ST. PETER STREET, MONTREAL.

BRANCH OFFICES—Toronto, Imperial Building, Adelaide St.; Winnipeg, 909½ Main Street; Vancouver, Anderson & Miskin, Imperial Block, Seymour and Pender Streets; Edmonton, Walker & Barnes, 562 Second Street; Calgary, General Supplies Limited, 1233 2nd Street East.

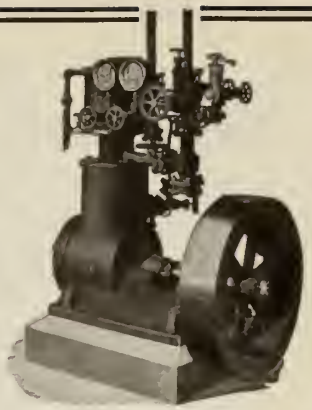
The advertiser would like to know where you saw his advertisement—tell him.

ESTABLISHED 1867

THE VILTER MANUFACTURING CO.

242 BECHER ST., MILWAUKEE, WIS., U.S.A.

A small machine for small Ice-making and Refrigerating Plants, as well constructed and as successful in operation as larger outfits. VERTICAL SINGLE ACTING AMMONIA COMPRESSORS, different sizes. Built with fewest possible number of parts. Sold at low price. Excels all others of like size in every point—simplicity, efficiency, reliability, smoothness of action, etc. We build horizontal and vertical ICE-MAKING AND REFRIGERATING MACHINERY, a full line of CORLISS ENGINES, and MACHINERY FOR BREWERS AND BOTTLERS. Our plant covers more than eight acres of ground.



Vertical Single-Acting Ammonia Compressor, Enclosed Type for Belt-drive.

The

LINDE BRITISH

Refrigeration Co. Limited

¶ Numerous fully authenticated laboratory tests organized from time to time in America and Europe, have invariably served to demonstrate in an unanswerable manner, the very remarkable degree of mechanical efficiency to which our products have been brought. ***The history of mechanical refrigeration is our history.***

Head Office: LONDON, ENG.

BIRMINGHAM	GLASGOW	JOHANNESBURG, S.A.
BRISTOL	BOMBAY	SYDNEY, N.S.W.
LIVERPOOL	CALCUTTA	PORT NAPIER, N.Z.

Coristine Bldg.
MONTREAL, P.Q.

"Angle or Globe"

"AUTOMATIC"

Cushion Non-Return and Triple-Acting Valves

"Work Both Ways"

Largest Steel Co. in the world ordered over 1000 of our valves for the protection of their

"Power Stations"

References
Canadian Northern Ry.
T. Eaton Co.
Toronto, Can.
Canadian Pacific Railway
City of Vancouver, B.C.
Armour & Co.
U. S. Steel Corp.
National Tube Co.
Illinois Steel Co.

"AUTOMATIC"

"The Controlling Altitude Valve"

maintain a uniform stage of water in stand-pipes, reservoir or tanks.

No overflow in case of fire, pressure. Valves automatically closed by water or electricity.

"Quick Closing Valves"
"Sandpipe Valves"

Automatic Valves
For Steam and Water Service

Anderson Reducing Valves for Steam or Water.

GOLDEN-ANDERSON VALVE SPECIALTY COMPANY

1233 Fulton Building
PITTSBURGH, PA.

WILLIAM SCHON, Proprietor.

Ungar's Laundry & Dye Works

60-70 Barrington Street

HALIFAX, N.S. July 18th.1911

The Federal Engineering & Supplies,Limited
TORONTO

Dear Sirs:-

We are in receipt of your favor of the 4th.inst. and note all you say re Scandinavia Belting. We may say that since giving our first order for a Scandinavia Belt,we have been using them in our establishment,whenever and wherever possible.

At the first of this year we shifted our Washing, Department from our old building to the new one and at the same time ,having purchased a new Engine,we were in need of a main Belt over 50 feet long,so had no hesitancy at all in ordering Scandinavia as we knew exactly what it was capable of and what it would stand in the way of wear and tear. During the time we were using our first Belt of this brand,there were two fires in our immediate vicinity and the Belt was covered with water,lime and dirt for twelve hours each time,but after wiping off the dirt,we were able to start up and run with the Belt the same as if it had never been through any such test, no damage whatever having resulted therefrom.

Yours truly,

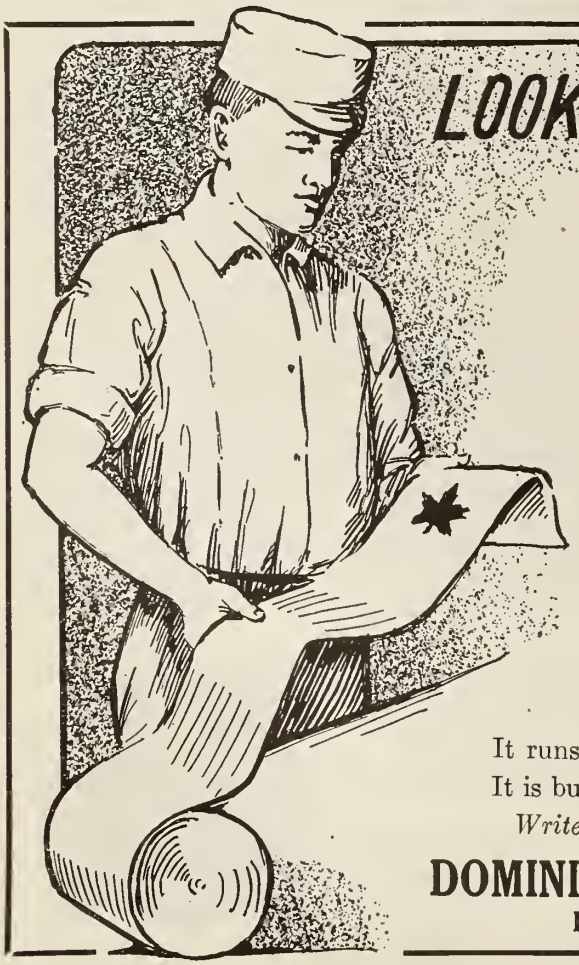
UNGAR'S LAUNDRY & DYE WORKS.
Per.

SCANDINAVIA BELTING
FEDERAL ENGINEERING & SUPPLIES LIMITED
TORONTO

It will pay you to investigate Scandinavia Belting

Federal Engineering and Supplies, Limited

Toronto Montreal



LOOKING FOR THE "MAPLE LEAF"

is increasingly a habit with those who buy much Belting.

The reason is not hard to find, for there is no part of your Belting system, from the main drive to the smallest light Belt for power transmission, where you will not get the best kinds of service from

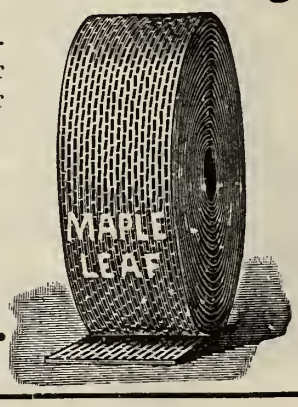
"MAPLE LEAF" BRAND Stitched Cotton Duck Belting

It is the most economical Belting because it is durable under every condition; even where other Belting will deteriorate rapidly. It is water proof.

It runs absolutely true on the Pulleys.

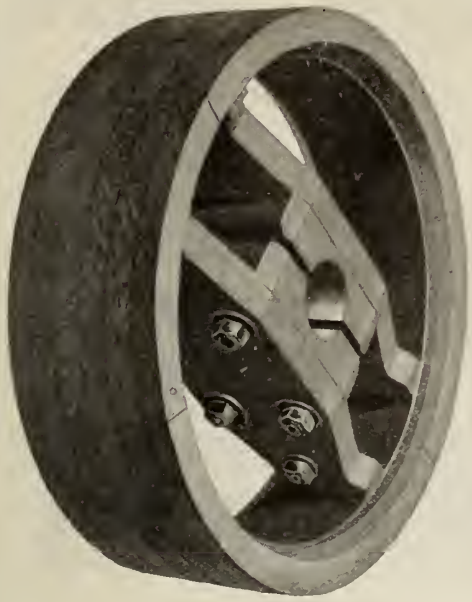
It is built of plies of selected duck.

Write for Information and Prices.



DOMINION BELTING CO., Ltd.
HAMILTON, CANADA

A Combination Hard to Beat

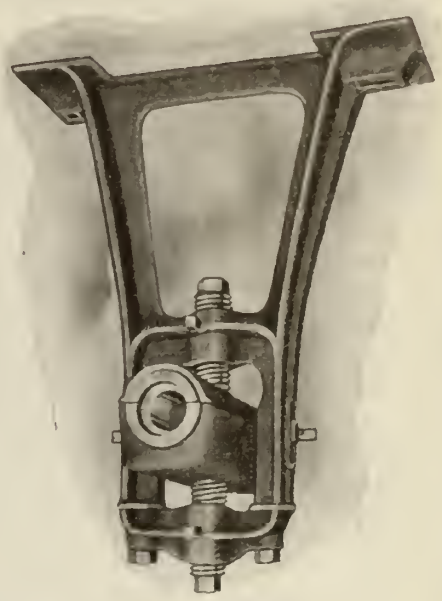


Elmira Ball and Socket Hangers

Elmira Wood Split Pulleys

The Elmira B. & S. Hangers are designed to meet the hardest and most exacting conditions. They are of good weight, correct design, and well proportioned. A Duplex system of oiling is employed consisting of tempered steel rings and woven cotton wick.

The Elmira Pulley is built to stand the hardest service and most severe conditions. The rim is nailed throughout. The arms are tenoned into the rim and dowelled there. The pulley is guaranteed to run wherever a leather belt will give satisfaction.

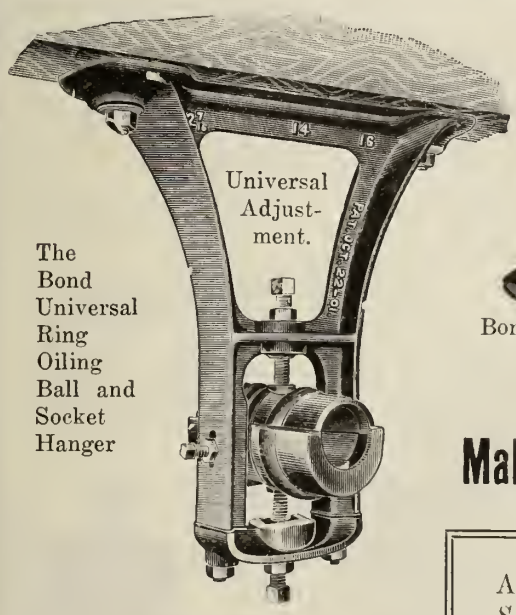


Send for our Illustrated Catalogue "C."

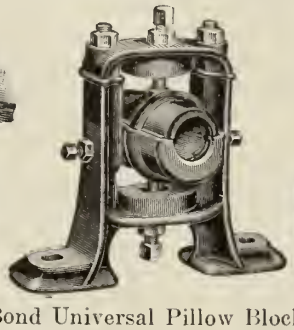
Large and complete stocks carried at Elmira, and by

The A. M. ELLICOTT CO., 301 St. James Street, Montreal, Que., Sole Eastern Agents.

Elmira Machinery & Transmission Co., Limited - - Elmira, Canada



The Bond Universal Ring Oiling Ball and Socket Hanger

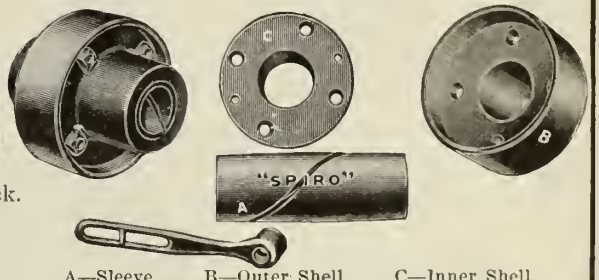


Bond Universal Pillow Block.

THE BOND PATENT "SPIRO" COMPRESSION COUPLING

Double-sure Grip on Shaft.

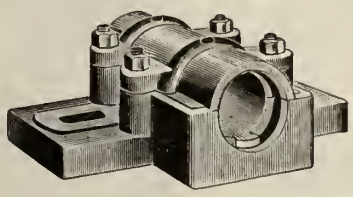
50% more gripping force than any other compressions coupling.



A—Sleeve. B—Outer Shell. C—Inner Shell.

Make Assurance "DOUBLE SURE" and take a "BOND"

All bearings are Babbitted and reamed. *Send us a trial order* and you will soon be convinced that the *"Bond"* is the best that you have ever used.
Write for complete catalog 25.

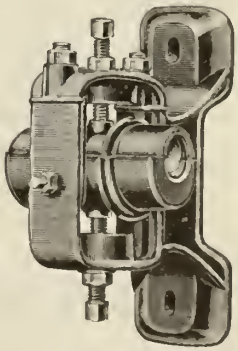


The "Bond" Rigid R. O. Pillow Block.

Canadian Bond Hanger & Coupling Co., Ltd.

Manufacturers

ALEXANDRIA ONTARIO



Bond Post Hanger.

The advertiser would like to know where you saw his advertisement—tell him.

Don't Lose Money

Through long waits for renewal of Broken Machinery Parts

Let Us
WELD Your Breaks

Our emergency repair outfit is in charge of experts who will make the broken part as efficient as the original in only a few hours from the time that trouble occurs.

The small cost of welding cannot be compared with the cost of waiting for a new part.

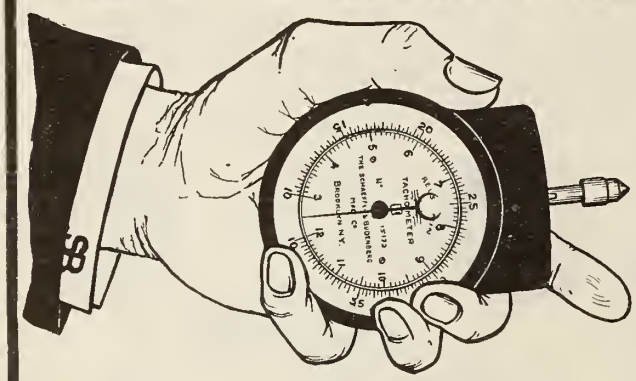
Nothing too large or too small for our capacity. Our work is fully guaranteed.

Send us a trial job and let us quote you prices. Keep us in mind—you will need us in a hurry some day.

The Franco-Canadian Welding Co.

Head Office for Canada: **331 YONGE STREET, TORONTO, CAN.**

TELEPHONES: Day Calls—Adelaide 198. Nights and Holidays—Hillcrest 431.



Have You a Tachometer?

If not, you ought to have one. You know what they are for, don't you? You know that the Tachometer is a solver of speed problems.

When the speed of a certain shafting, turbine, motor, machine or the like bothers you, a Stationary type of Tachometer is installed and your troubles are ended. When there are numerous different shaftings to be tested a Hand Tachometer is needed. And the best in hand tachometers is represented by our line of

S & B "Columbia" Tachometers

They are the neatest, most compact and durable Hand Tachometers on the market. And as for accuracy they are unequalled. There are numerous styles for every purpose at varied prices. They possess important individual features not found in other types.

And we don't stop at hand tachometers, for we have a complete line of Stationary Indicating and Recording Tachometers for every conceivable purpose. All described in our Tachometer bulletin.

Write for Bulletin W 23—Now.

THE SCHAEFFER & BUDENBERG MFG. CO.

93

Chicago **BROOKLYN, N.Y.** **Pittsburgh**

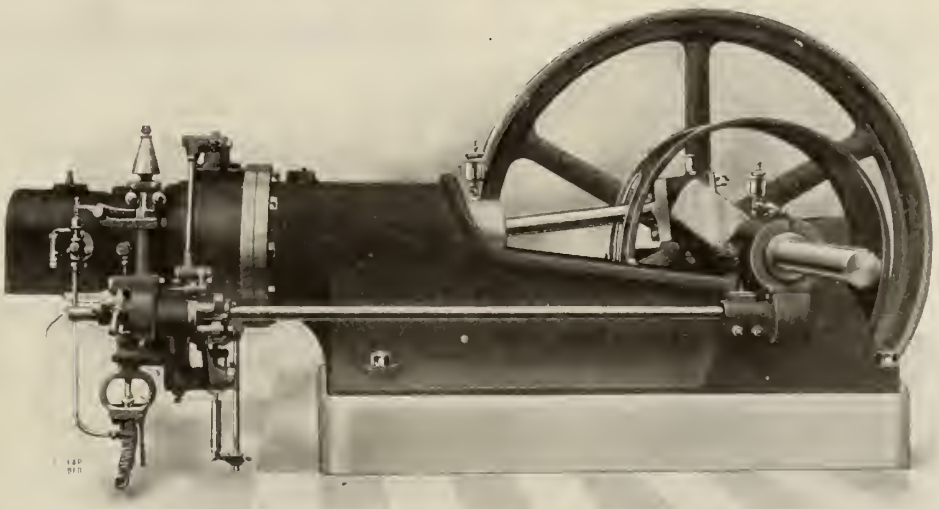
The advertiser would like to know where you saw his advertisement—tell him.

ESTABLISHED 1870.

JOHN ROBSON, (Shipley), Ltd.

SHIPLEY, Yorks, England.

Sole Makers of the **"Robson"** Oil Engine for working on Crude and Petroleum Oils.



Sole Makers of the **"Robson"** Engine for working on Towns and Suction Gas.

"Photograph of Oil Engines, (new design) 3½ to 20 B. H. P."

Suction Gas Producer Plants for working on Anthracite Coal, Coke or Charcoal.

AGENTS WANTED. **WRITE FOR CATALOGUE.**

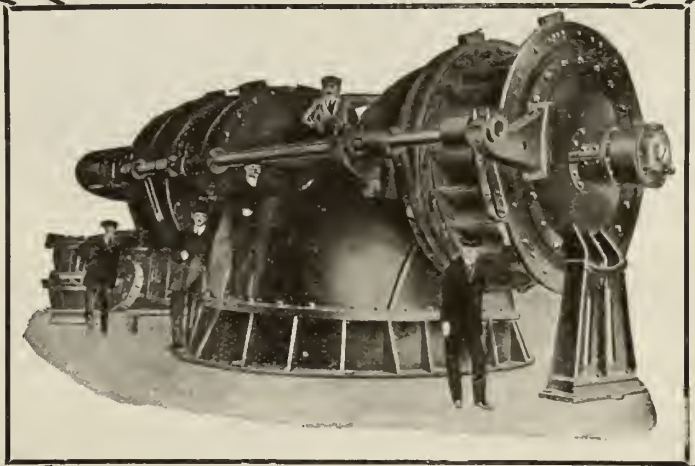
WATER TURBINES

—AND—

GOVERNORS

All Sizes

Maximum Efficiency



All Heads

Ideal Control

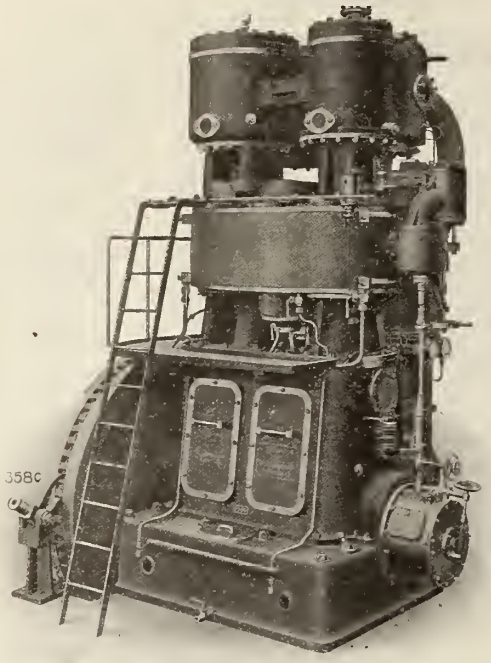
ASK FOR PARTICULARS FROM

THE CANADIAN BOVING CO., LTD.

164 BAY STREET, TORONTO.

Branch Office for British Columbia, 427 Seymour St., Vancouver

AIR COMPRESSORS

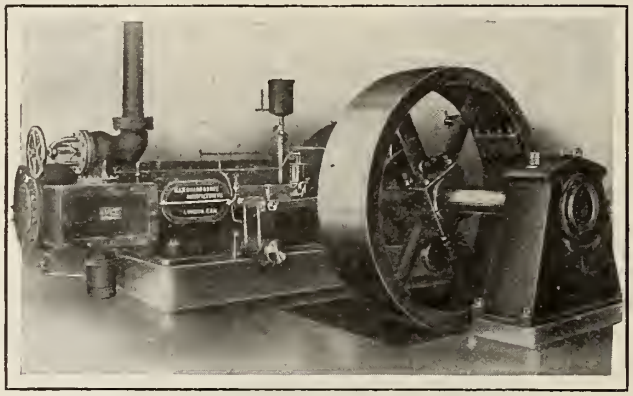


Belliss Compressors
are coming into favor in Canada, because of their

Low Initial Cost
High Efficiency
Reliability
Low Cost of Up-keep
Low Oil Consumption

MANUFACTURED BY
BELLISS & MORCOM, LTD.
BIRMINGHAM, ENG.

AGENTS:
LAURIE & LAMB
ENGINEERS
BOARD OF TRADE BLDG., - MONTREAL



Side Crank Leonard Automatic Engines

Particularly adapted for Direct Dynamo Connection and Electric Light Service. Made in Simple and Compound Units up to 500 Horse Power. For High Economy and Close Regulation this engine is unexcelled.

We also make High and Slow Speed Corliss Engines for Heavy Duty Service. Our "Tangye" Engine is very well and favorably known throughout Canada for Sawmill Work.

MADE BY
E. LEONARD & SONS, LONDON, ONTARIO
MANUFACTURERS OF
High and Slow Speed Engines of all kinds, Boilers, Heaters, Pumps, etc., etc., and complete Steam Plants.
WAREHOUSES AND AGENCIES AT
MONTREAL, ST. JOHN, N. B., CALGARY, WINNIPEG, VANCOUVER

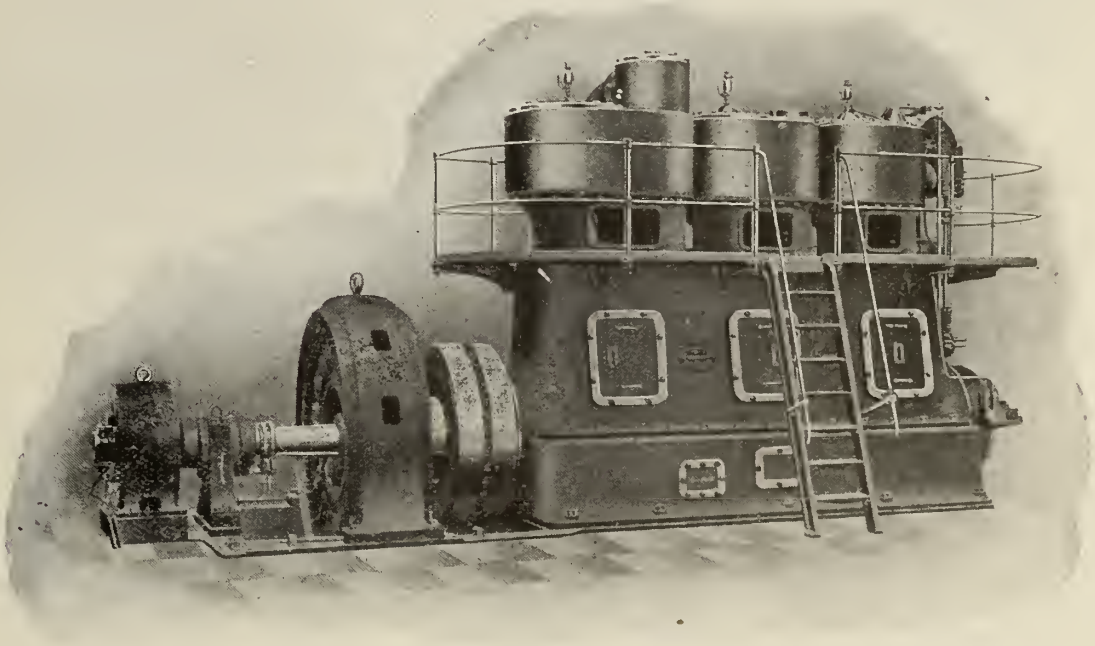
The advertiser would like to know where you saw his advertisement—tell him.

The "Browett-Lindley"

Quick Revolution, Forced Lubrication, Double Acting Steam Engines

Simple ***Efficient*** ***Economical***

These engines have established a high reputation in electric light and tramway plants, collieries, cotton and paper mills, steel and iron works, etc., and are made in five different styles to suit steam pressure and working conditions.



Three-crank, Triple Expansion, "Browett-Lindley" Engine driving 500 K.W. Generator.

Sole Agents for Canada :

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

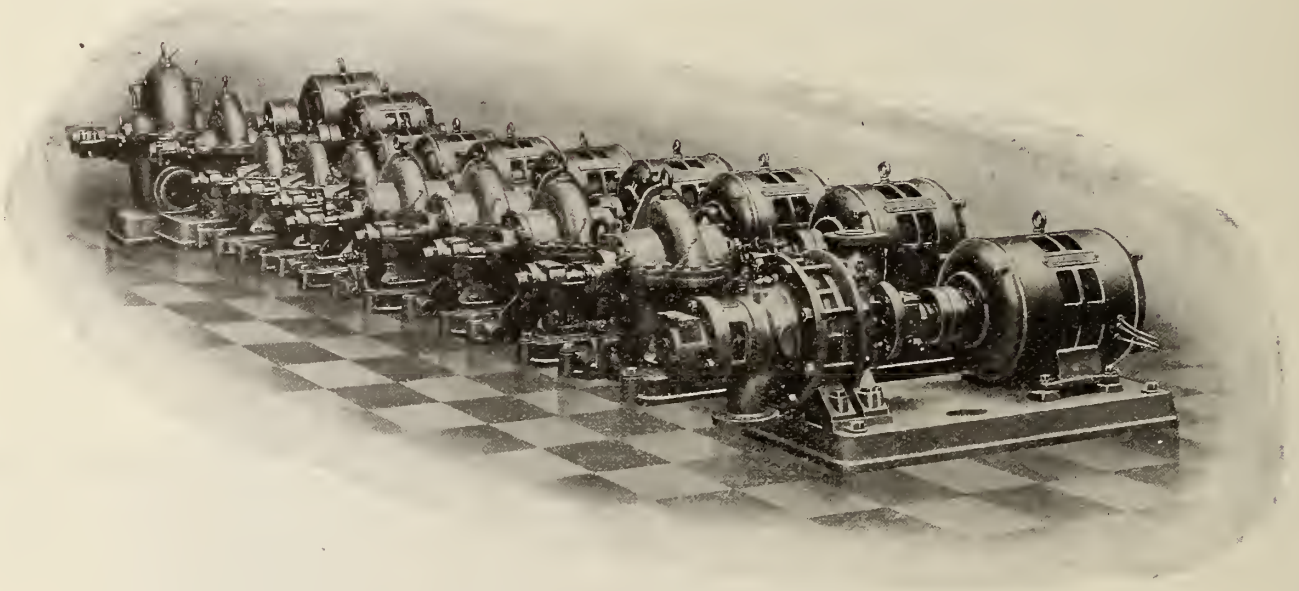
Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs & William Sts., MONTREAL. **Sales Offices: Montreal, Toronto, Cobalt, Winnipeg, Calgary, Vancouver**

The advertiser would like to know where you saw his advertisement—tell him.

W. H. ALLEN, SON & CO., LIMITED

BEDFORD, ENGLAND



The ten pumps illustrated above, are used for Main Water, Caustic Liquor, Special Digester and Boiler Feed purposes. From 10 to 150 B.H.P. These are for a well-known Pulp Mill in ONTARIO.

Canadian Representatives:

CHAPMAN & WALKER, LIMITED

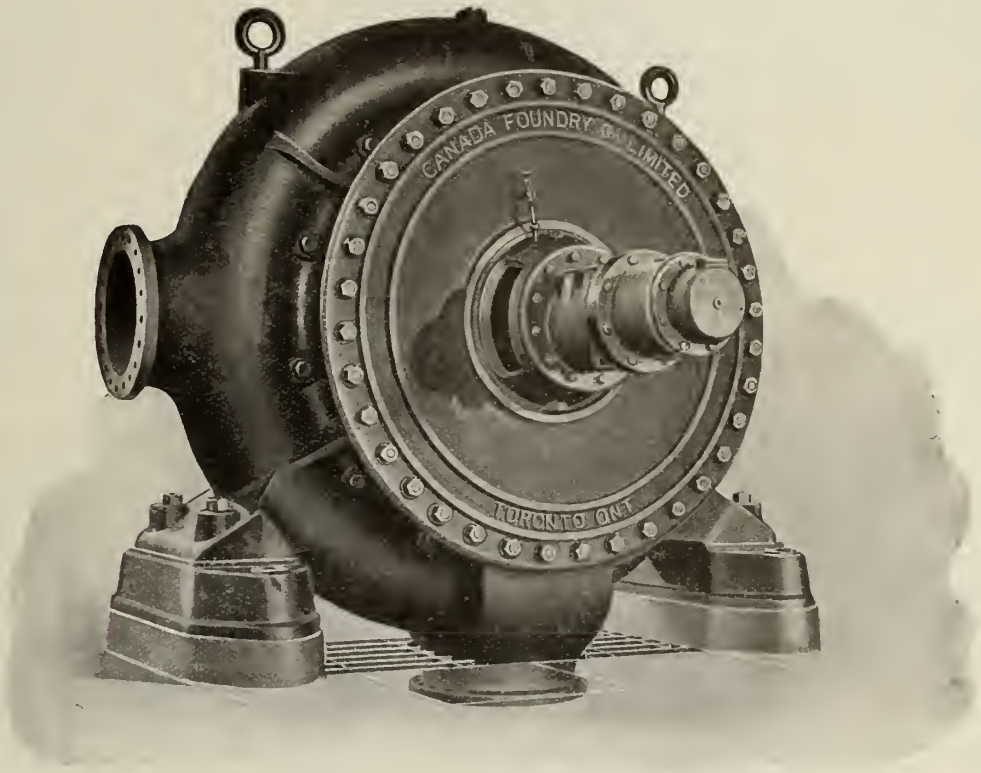
Engineer for Canada: A. LEO MIEVILLE, A.M. CAN. SOC. C.E., A.M. I. MECH. E.

Head Office: 69 Victoria Street, TORONTO, CANADA

Mather & Platt, Limited

PATENT TURBINE PUMPS

For All Duties



24″ Single Stage Turbine Pump

Sole Licencees for the Manufacture in Canada
of the "Original Turbine Pump"

Canada Foundry Company, Limited

Head Office and Works, TORONTO

District Offices:

Montreal Halifax Ottawa Cobalt Porcupine Winnipeg Calgary Nelson
Vancouver Victoria Prince Rupert

ECONOMY and SERVICE

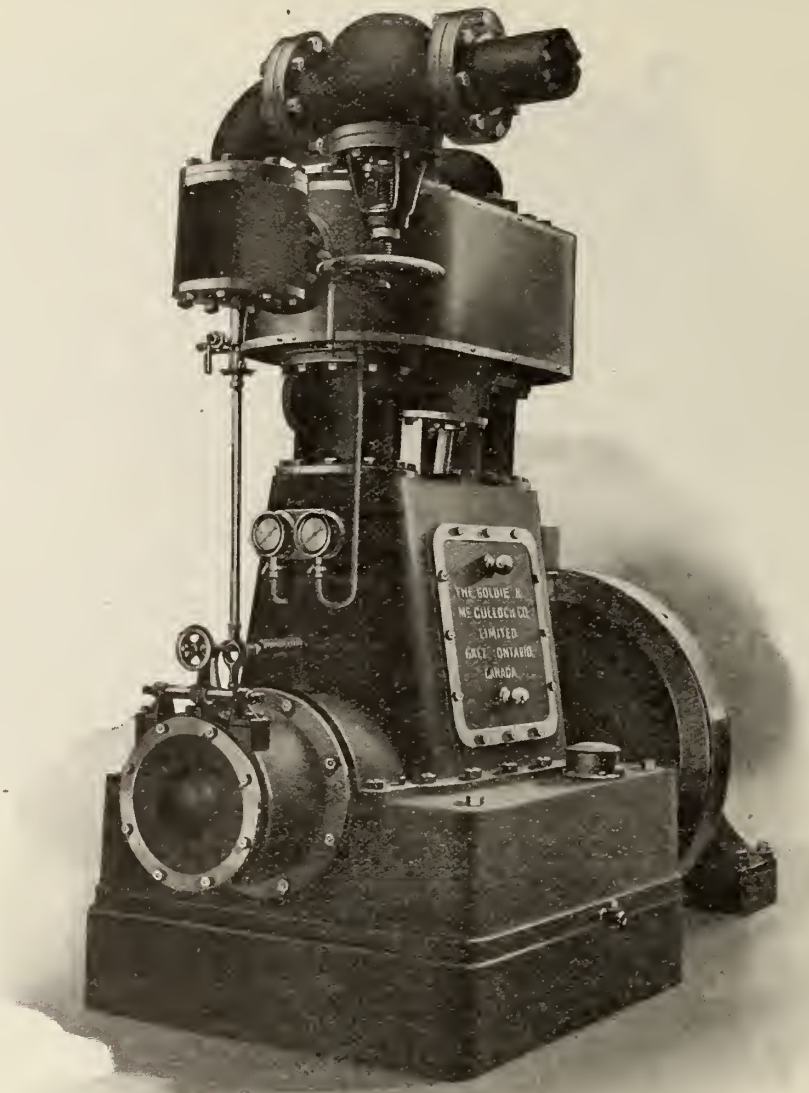
are the two most important considerations

IN THE RUNNING OF YOUR POWER PLANT

Is your present equipment running as economically as it might be ?
Are you getting the Maximum Service ?

G. & McC. VERTICAL HIGH SPEED ENGINES

will give you, as they are giving others, a maximum service all the time, with a minimum cost of upkeep, and they require very little attention while running.



Are equipped with Forced Lubrication Systems. Run practically without vibration, are noiseless, and all working parts are very easy of access. They will save you money.

Twin Vertical, Forced Lubrication Steam Engine

ALL MATERIALS TESTED TO BRITISH ADMIRALTY REQUIREMENTS

The Goldie & McCulloch Co., Limited

GALT, ONTARIO CANADA

WESTERN BRANCH
248 McDermott Ave., Winnipeg. Man.

MARITIME PROVINCES
13-15 Dock Street, St. John, N.B.

QUEBEC AGENTS
Ross & Greig, 412 St. James Street, Montreal, Que.

BRITISH COLUMBIA AGENTS
Robt. Hamilton & Co., Vancouver, B.C.

Point du Bois, Winnipeg, Hydro-Electric Power Station

Through the courtesy of Mr. J. F. I. Thomas Montreal, Canadian representative of Vickers, Ltd., Sheffield, England, we are enabled to publish this comprehensive descriptive article on the constructional and equipment features of the above installation, and believe that our readers will find it both interesting and instructive.

THE purpose of this article is to give a description of the new hydro-electric station which has been built to supply electric power to the city of Winnipeg. The station, the designs for which were put in hand in 1906, was completed in the latter part of 1911 and is now in operation. The supply system, of which the station forms a part, is a new one and will not be worked in conjunction with the earlier system of the city, but in competition therewith, since the new system is a municipal one, while the earlier is in the hands of a company.

The new station is situated at the Point du Bois Falls, on the Winnipeg River, some 70 miles from Winnipeg, so that the electrical scheme includes not only the power-station, but a 77-mile transmission line and a terminal station in the city, in addition to various sub-stations and the distribution network. The power-station machines generate current at 6,600 volts, which is stepped up to 72,000 volts for the transmission lines. At the terminal station, this pressure is stepped down to 12,000 volts for distribution to the sub-stations, at which it is further reduced to 2,200 volts and 550 volts. The 12,000-volt distribution to the sub-stations is carried out by underground cables, while the lower pressure distributing network is both overhead and underground.

Location Features.

The Winnipeg River, with its tributary the English River, has a watershed of some 52,000 square miles, situated in Northern Minnesota, North-West Ontario and Eastern Manitoba. The average rainfall in the area is from 18 in. to 25 in., and the river flow at the Point du Bois Falls was 16,000 cub. ft. per second as a minimum and 55,000 cub. ft. per second as a maximum during the years 1907 to 1910. Old flood-marks suggest that flows of 90,000 to 100,000 cub. ft. have been reached. On the whole, however, the flow is very uniform as compared with other Canadian rivers, this state of affairs being largely accounted for by the large amount of virgin forest land and the great number of lakes in the watershed. The total lake area is 5,650 square miles, the largest lake of the district—the Lake of the Woods—through which the river flows, having an area of 1,200 square miles.

There are no falls of great height on the river, the total fall, in a distance of 347 miles from the mouth at Lake Winnipeg, averaging about 2 ft. per mile. The natural fall at the Point du Bois was from 28 ft. to 33 ft., but on the construction of the power-house this fall was increased to from 43 ft. to 47 ft. by building dams and drowning out smaller falls up stream. The dams have resulted in the formation of a reservoir of 6,000 acres in extent, which gives such ample storage that there is no fear that the station will not be able to meet all demands for power during any season. It is estimated that the water supply will allow of the generation of an average of 65,000 horse-power for twenty-four hours at all times.

Power Station Site.

The site of the power-station, and the general plan of the works carried out at Point du Bois, are shown in Fig. 1. It will be seen that the river falls over two natural rock barriers in its passage round the Point du Bois, and that by building a rock dam and spillway across the narrowest part of the stream, the level of the water above the falls has been raised to form the reservoir. As before stated, the natural level has been raised sufficiently to drown out some smaller falls up stream. The building of the dam and spillway is the only interference that was necessary with the river-bed proper, as the supply to the power-station has been arranged for, by cutting a forebay canal on the western side of the river and across the base of the point.

As will be seen from the figure, the canal intersects an arm of the original river, and a spillway from the forebay

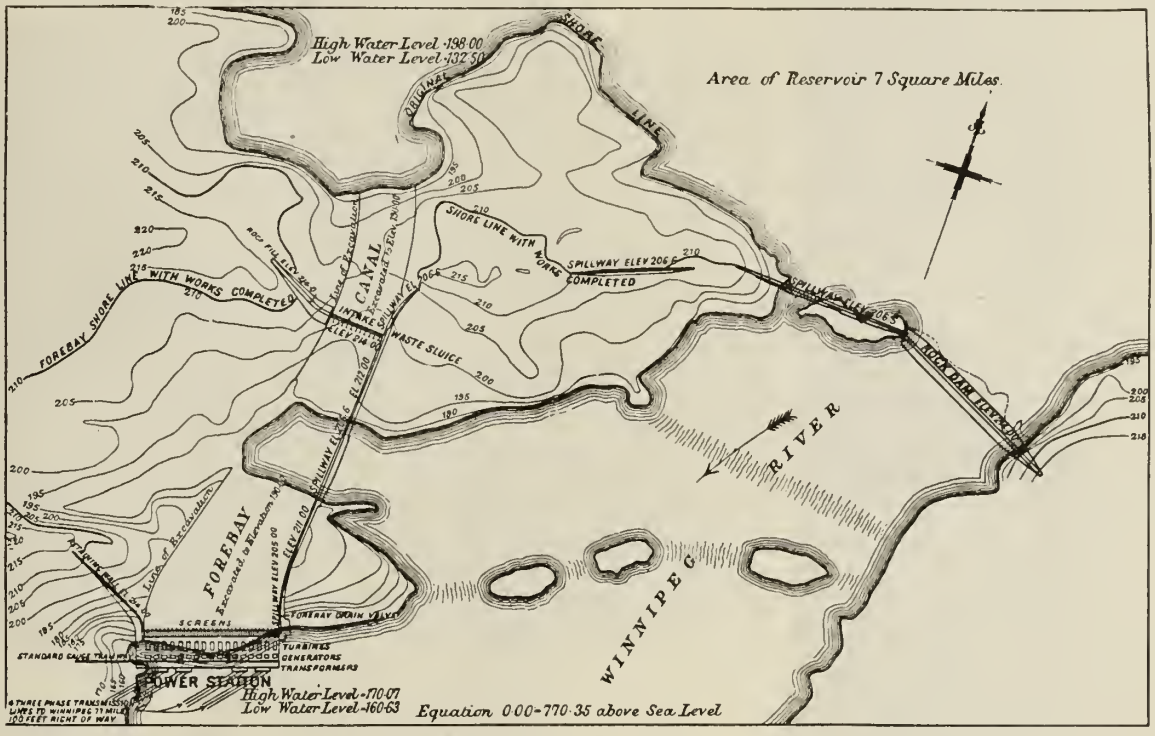


FIG. 1. PLAN OF WORKS AND POINT DU BOIS FALLS.

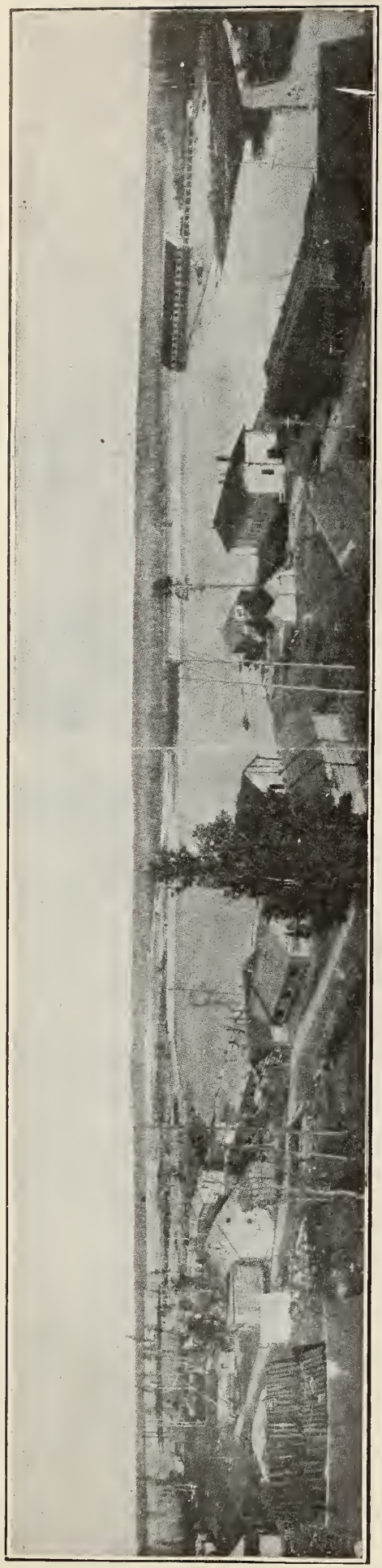


FIG. 3. GENERAL VIEW OF FOREBAY CANAL AND POWER STATION.

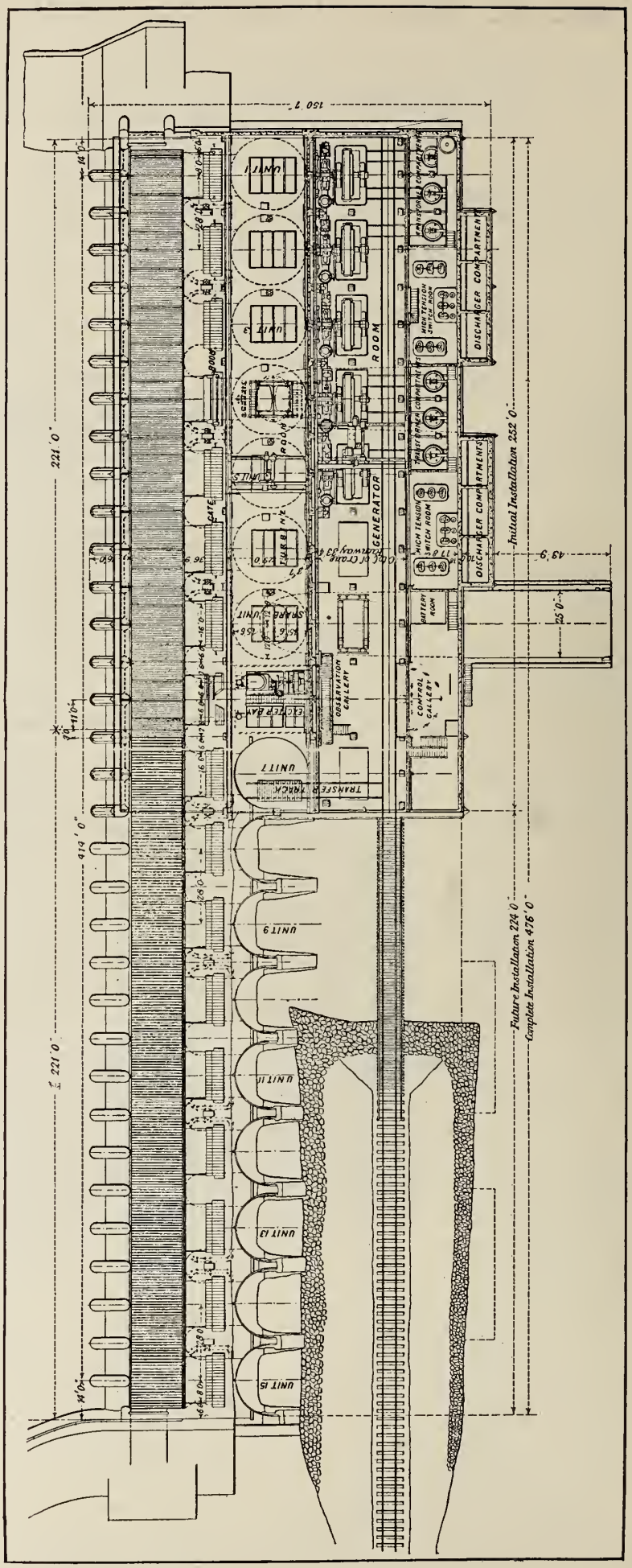


FIG. 4. PLAN OF POWER STATION.

has been constructed, communicating with the downstream side of the rock dam. The eastern side of the forebay canal is in the main formed by a retaining wall. In addition to the two spillways already mentioned, there are two situated on the land originally dry, one running approximately east and west across stream, and the other being situated in the canal wall above the intake. The total length of these spillways, or weirs, is 1,500 ft. The crests of the weirs are 7 ft. 4½ in. below the normal water head of the reservoir. The whole of these spillways, together with the the canal retaining walls and the wing wall to the western side of the power-station, were built in concrete. A general view of the forebay canal and other work is given in Fig. 3.

The position of the power-station is shown in Fig. 1, while details of its construction are given in Figs. 4 and 5. The building, which is constructed almost entirely of concrete and steel, has its foundations directly on the natural granite which forms the site. On its north side an upward sloping reinforced concrete apron has been built on a series of supporting walls. This apron, which is 18 in. thick, serves to control the direction of the water in its path into the station, and in addition acts as a gravity dam. The water screens are carried above this apron, as shown in Fig. 5. A view of these screens is also given in Fig. 2. The apron is tied to the wheel-pits on its south side, and these in turn are connected up to the tailrace walls. The wheel-pits, galleries and roofs of the building are made of reinforced concrete. The main walls are of plain concrete.

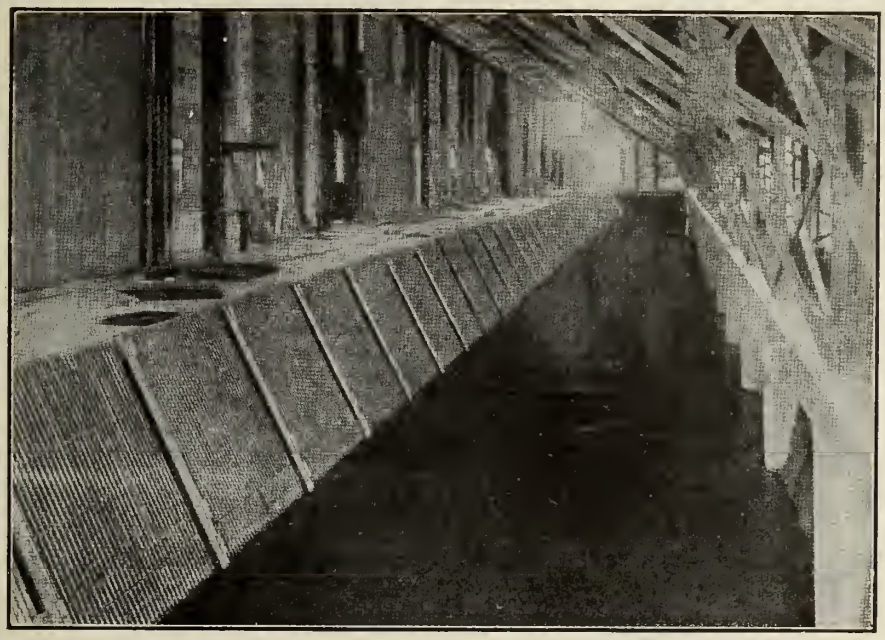


FIG. 2. VIEW OF SCREENS.

Station Arrangement.

The general arrangement of the station, and the passages through which the water reaches and leaves the turbines, will be clearly seen from Figs. 4 and 5. The water enters the wheel-pits through inlets, 16 ft. by 20 ft., which have rounded piers between them, and passes on its way through the screens, 45 ft. long and set in a slope as shown. The screens are made in 7-ft. bays, and are supported by sets of three struts, which are attached to a common foot-plate. This arrangement was adopted as offering the minimum of resistance to the flowing water. The head-gates are situated between the racks and the wheel-pits. They are made with a steel framework covered with pine sheathing. The turbine exhaust-passages are 10 ft. by 15 ft., of oval section at the point of intersection with the turbine-pit floor, and expand to 13 ft. by 23 ft. at the point of outlet. As the head under which the turbines work is of moderate height only, a very large amount of water has to be dealt with, and considerable attention was accordingly required in connection with the question of the velocity of the water in the various parts of the plant. The station will ultimately have a capacity of 60,000 horse-power; and under full-load conditions with such an output, the water would have a velocity of 6.4 ft. per second through the intake in the fore-bay canal. As the canal gradually widens towards the power section, the water would decrease in speed, and pass through the outer piers of the gate-room at 1.5 ft a second. It would then increase to 1.7 ft. a second through the screens, 2.8 ft. a second through the wheel-pit inlets, and 20 ft. a second through the turbine runners. It would then decrease to 8 ft. per second through the neck of the exhaust-passage, and to 3.3 ft. a second, as this passage gradually increases in area.

Plant Capacity and Equipment.

As stated above, the station is arranged to ultimately accommodate 60,000 horse-power, but at present less than half this capacity has been installed, and only half the station has been built, with the exception of the apron and other portions of the north face, which have been completed as shown in Fig. 4. In view of the moderate head and the very large amount of water which would have to be passed through each unit if a very large size had been chosen, it was decided to instal two-runner turbines of 5,200 horse-power coupled to 3,000 k.w. generators. These units, at 45 ft. head, each pass 1,250 cub. ft. of water per second at maximum output. They run at 164 revolutions per minute. With this output, the water velocities stated are reached. Although the load which the station is to take would have justified units of 60,000 k.w. output, which could have been arranged for by installing four-runner units, it was considered that the very large water passages necessary would be undesirable, and 3,000 k.w. units, were finally decided on. The electrical apparatus in the station is arranged so that three of the 3,000 k.w. units shall normally run together and act as a single unit of 9,000 k.w. The ultimate installation will consist of five of such 9,000-k.w. units and one spare generator, the present installation consisting only of five 3,000-k.w. machines. This feature of the station will be referred to again when dealing in detail with the turbines and electrical gear.

Machines Testing Arrangements.

An interesting feature in connection with the turbines is shown in Fig. 4. This has reference to the arrangements which have been made for testing the machines. It will be seen that, commencing from the right-hand side of Fig. 4, there are six wheel-pits, which make up the first two 9,000-kw. units, and that there is then a single wheel-pit next to the space which is filled by the exciter turbines. This single pit is used for the testing of any machine, and is arranged with a special cast-iron frame above the exhaust passage, on which a machine can be set and lined up. The test is carried out by measuring the water actually passing through the turbine, the power output being, of course, obtained from the electrical end of the set. The water is measured by means of a rectangular flume, which has been built as an extension to the tail-race of the wheel-pit in

question, and which can be clearly seen in Fig. 4.

The amount of water passing through the flume is calculated from the velocity, which is ascertained by observing the movements of a vertical close-fitting diaphragm which hangs from a raft floating in the flume, and is free to move with the current. The walls of the flume are built of concrete, and in them flush oak blocks are set, carrying electrical contacts. There are three pairs of contacts—the first close to the power-house, the second 4 ft. 6 in. away from these, the third 25 ft. 9 in. away from the second, and the contacts are arranged in connection with electrical gear which records the instant at which the diaphragm passes each pair of contacts.

When testing a machine, the raft is drawn up close to the power-house wall, and held there until the load on the machine is constant and everything ready for the test. During this time, the diaphragm takes up an inclined position, owing to the discharge water passing under it. At a set time, the raft is released, and the diaphragm, falling by its own weight, is at the same time carried forward by the stream of water. On its pasage forward it makes connection with the contacts, so that a measure of its outward velocity, and so of the velocity of the water, is secured. The diaphragm is provided with a pointer projecting above the raft, this pointer indicating when it is vertical, so that if it is still in an inclined position when it passes the first pair of contacts, the reading from them is ignored and the time-interval between the second and third pair of contacts only is considered. This testing appliance was installed to the designs of the firm which supplied the turbines, the Canadian Boving Co., Bay St., Toronto.

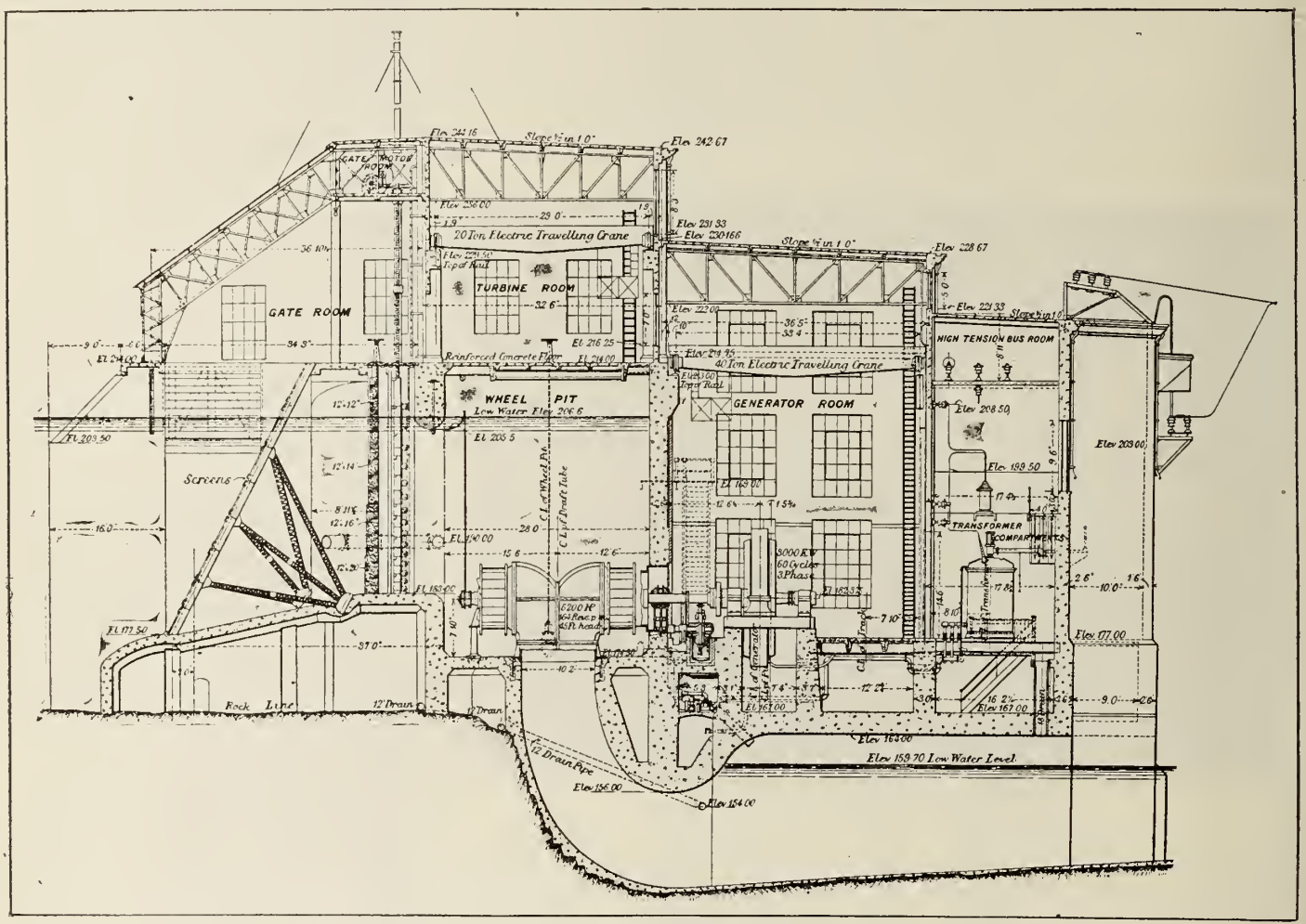


FIG. 5. CROSS SECTION THROUGH POWER STATION.

Arrangement of Equipment.

The general arrangement and the distribution of the plant in the power-station will be easily followed from Figs. 4 and 5. It will be seen that the building is divided longitudinally into four parts, containing respectively the water-screens, the turbines, the alternators, the transformer and switch-gear, and that annexes are built on the south side to hold the lighning-arrestors and outgoing-line connections. The head-gates between the screens and the wheel-pits work on rollers, and are lifted by means of vertical screws 40 ft. long, which rise through motor-driven nuts placed in the gate motor-room. The lifting motors drive horizontal shafts, and are arranged with clutches, so that one motor can lift any one of four gates. Stop-logs are arranged to be placed between the water-screens and the gates, if necessary, to serve as an alternative method of cutting off the water supply, or for use when it is desired to work in the gates. The turbine and generator-rooms are each fitted with traveling cranes as shown, while the distribution of the electrical gear will be clear from the figures.

Turbines Detail.

As stated in the previous part of this description, the station is equipped with 5,200 horse-power turbine units coupled to 3,000-kw. alternators, which generate three-phase current at 60 cycles and 6,600 volts. The turbines were supplied by the Canadian Boving Co., Bay street, Toronto, and the alternators by Messrs. Vickers, Ltd., of River Don Works, Sheffield. The turbines are of the two-runner type, and their general lines will be followed from Figs. 6 to 13. The main casings are of cast iron, and are carried by oval castings, which are

bolted above the concrete formation of the draught tube or exhaust passage. Additional support is attained at the outer ends by brackets resting on the concrete bottoms of the wheel-pits.

The machines have each three bearings, the inner being situated in the line of the wall separating the wheel-pits from the alternator-room, the outer being carried by the main casing and obtaining additional support from the bracket before mentioned, and the centre one being carried by the metal which forms the passages on the exhaust sides of the wheels. The whole arrangement is clearly shown in Fig. 6. The two outer bearings are lubricated with grease supplied by pumps driven from the turbine-shaft, while the inner bearing has ring lubrication, as shown. This inner bearing is ,of course, accessible from the alternator-room.

The wheels have cast-iron hubs with forged-steel plate buckets, and are keyed to the shaft, which is carried right through the machine, and has a coupling at the inner end, to which a short length of shafting is attached. This length of shaft is coupled to the alternator at its inner end. The wheel gates are of the shutter type, and are operated by means of two gate-shafts which run along either side of the turbine in the same horizontal plane as the main shaft. They are clearly shown in Fig. 7, and can be seen in Figs. 8, 10 and 11.

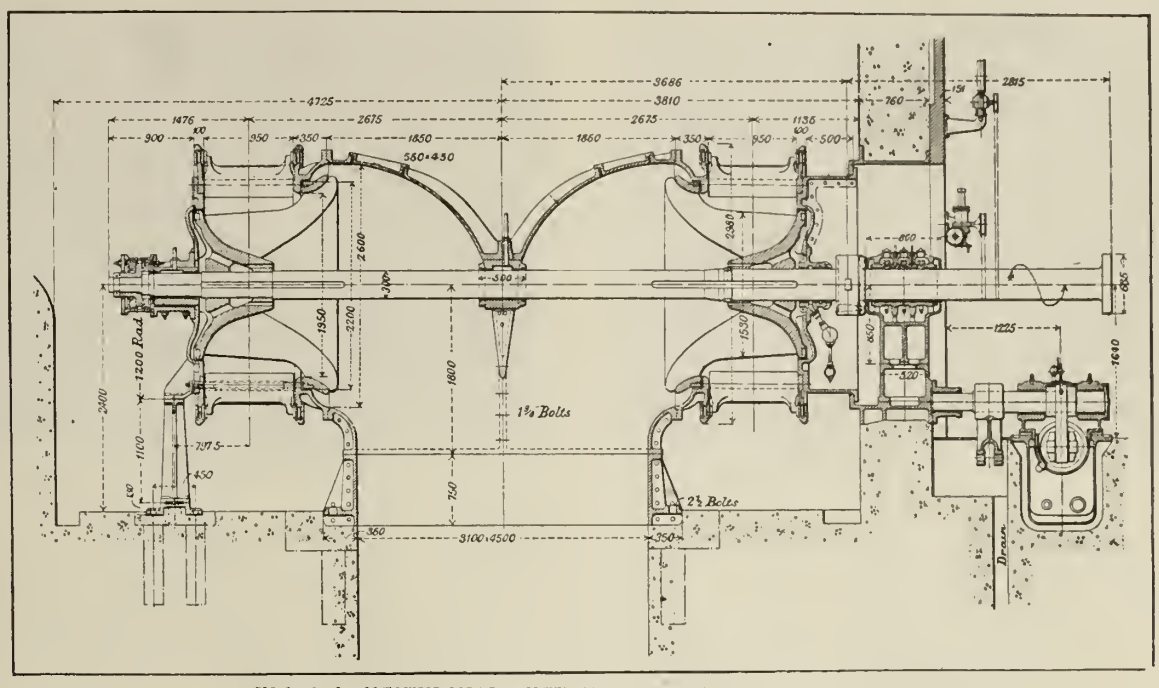


FIG. 6. LONGITUDINAL SECTION THROUGH 5,200 H.P. TURBINE.

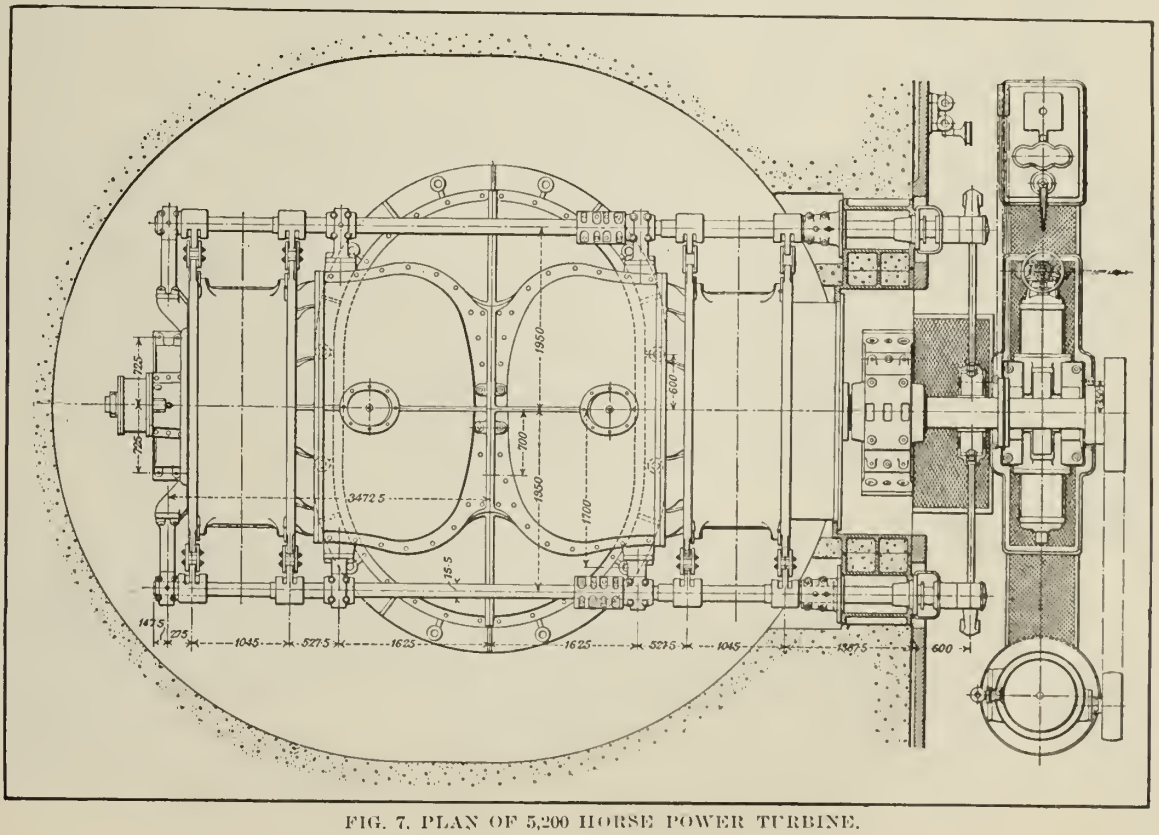


FIG. 7. PLAN OF 5,200 HORSE POWER TURBINE.

The arrangement of the gate-shutters can be followed from Figs. 6 to 9.

The operating shafts are connected up by links to rings which lie on the outside of the wheel casing, and which are in turn attached by short links to the shutters, as shown in Fig. 9. The rotation of the gate-shafts rotates the rings, so that the shutters can be opened or closed. The shafts are operated by means of the crank-and-link mechanism shown in Figs. 12 and 13, which is driven by a pair of oil-cylinders, acting in conjunction with the governor gear.

Governor and Gate Operating Gear.

The whole of the governor and gate-operating engine arrangements are situated in the alternator-room, as shown in Figs. 6 and 7. The operating engine is best seen in Fig. 12. It consists of two vis-a-vis cylinders, supplied with oil from a pump situated in the lower part of the oil reservoir, shown at the left-hand side of Figs. 12 and 13, and driven by means of a belt from the turbine shaft, as indicated by dotted lines in Fig. 12, and as shown in plan in Fig. 7. The oil-pump supplies oil to the cylinders through the intermediation of valves, which are controlled by the governor. These valves are shown at the right-hand side of Fig. 12. This figure also shows the connecting pipes between the oil-pump, the valves, and the cylinders.

The mechanism operates by means of a balanced valve, which is connected up

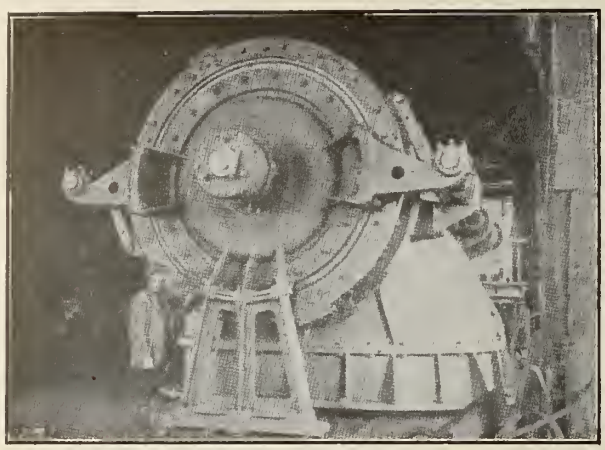


FIG. 8. VIEW OF TURBINE FROM OUTER BEARING END.

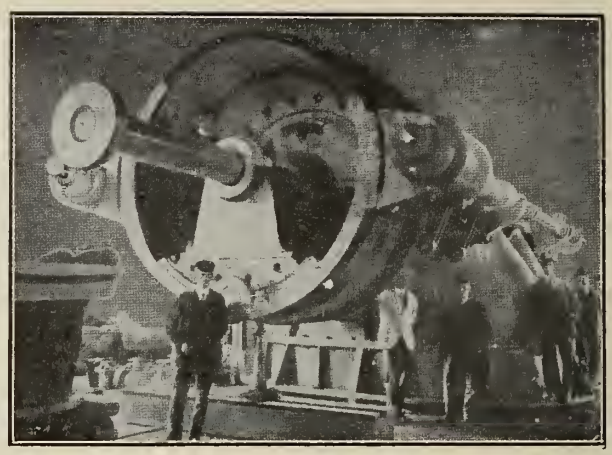
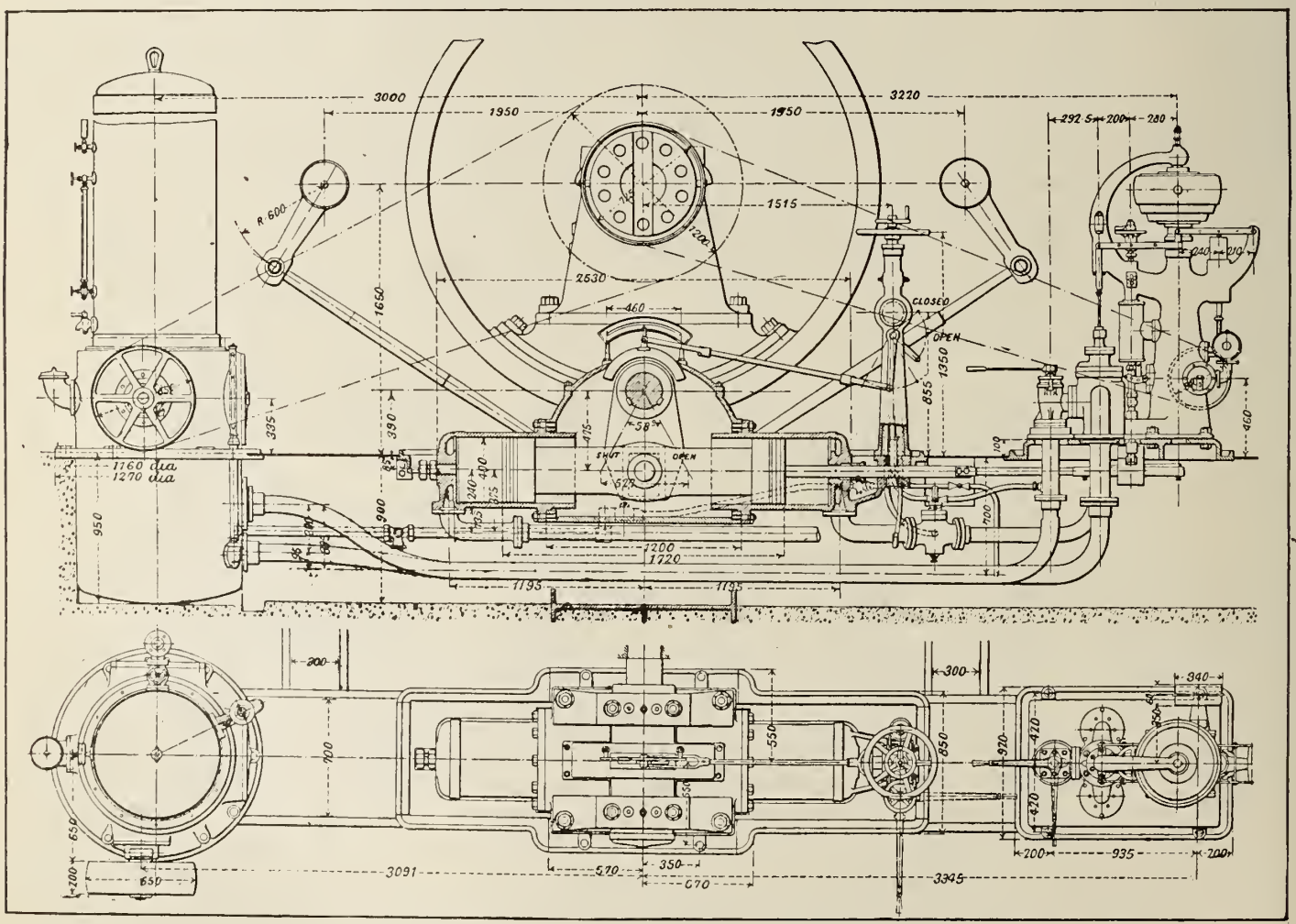


FIG. 10. VIEW OF TURBINE FROM ALTERNATOR END.



FIGS. 12 AND 13. VIEWS OF GOVERNOR GEAR AND GATE-OPERATING ENGINE.

to the lever meehanism of the governor, as shown in Fig. 12, the governor being driven by two belts from the main shaft, whieh are indicated in the same figure. The position of the balanced valve, which depends on the speed of the governor, is sueh that, when running at normal speed, the oil pressure is equally maintained on eaeh of the vis-a-vis eylinders, so that the wheel-gates are held in a fixed position. Increase or decrease of speed, however, puts one or other of the eylinders to exhaust, so that the pistons move respeetively in or out, and the gates are adjusted to suit the new conditions. There is an eleetrieal attaehment on the governor controlled from the switeh-gallery, whieh can be used to operate the balanced valve when necessary and partieularly during synchronizing. A by-pass arrangement is fitted in eonneetion with the hand-wheel pillar shown, for use when starting up.

The low-pressure and high-pressure oil-reservoirs of the governors of the various units are interconneeted by means of a system of pipes, and in an emergency any, or any two of the pumps may be stopped, the corresponding gate-operating engine or engines, being then supplied with oil from the pumps of the other sets. All the pumps are of sufficient capacity to allow of this arrangement. A view of one of the main governors is given in Fig. 17. The turbines have a guaranteed efficiency of 84 per cent. at full load, and run at 164 revolutions per minute. The governor gear is such that when 20 per cent. load is suddenly thrown off or added, the maximum momentary speed variation is 2.5 per cent., and when 100 per eent. load is thrown off or added, the variation is 15 per cent.

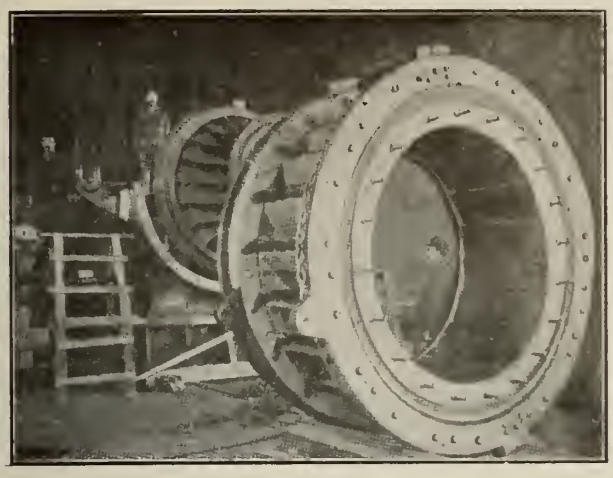


FIG. 9. VIEW OF WHEEL CASING SHOWING SHUTTERS.

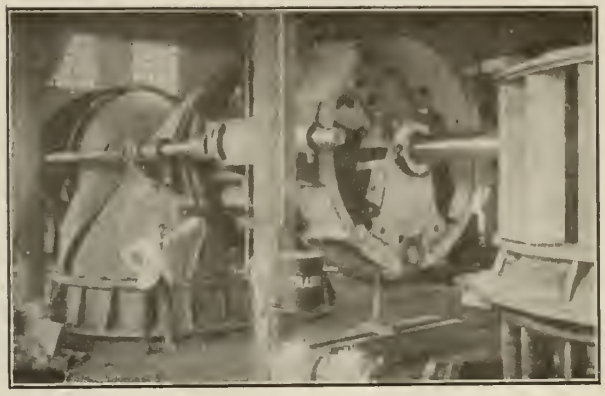
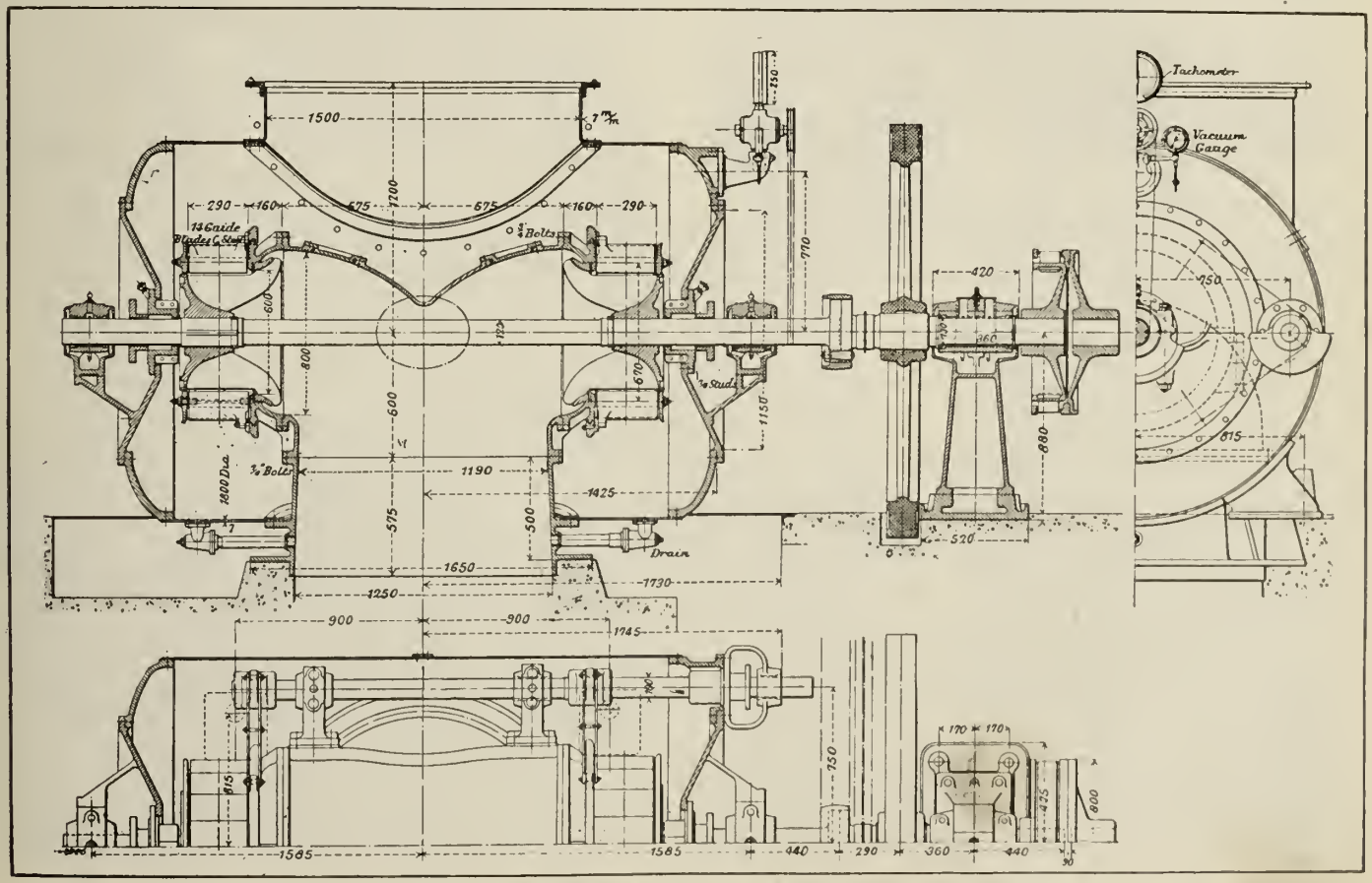


FIG. 11. VIEW OF TURBINE FROM ALTERNATOR END.

Exciter Units.

There are at present two exciters fitted in the station, each of 250 kw. eapacity and driven by water-turbines, running at 500 revolutions per minute, also snpplied by the Canadian Boving Co.



FIGS. 14-15-16—ELEVATIONS AND PLAN OF EXCITER TURBINE.

The position of these exciters can be well seen in the plan of the station which was referred to in the earlier part of this description and will be found in Fig. 4, while views of the exciter turbines are given in Figs. 14 to 16, and a general view in Fig. 19. As will be seen from these figures, the turbines are not set in wheel-pits as are the larger machines, but they have been provided with outer casings, on to which supply-pipes are fitted. The turbines are situated in a special bay, built between two of the main wheel-pits, and the supply-pipes are carried through the wall into the gate-room.

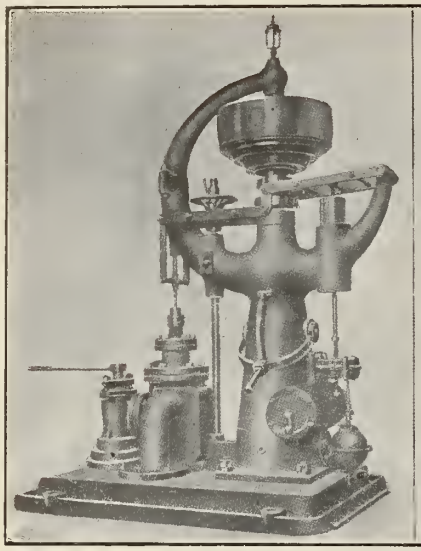


FIG. 17. MAIN GOVERNOR.

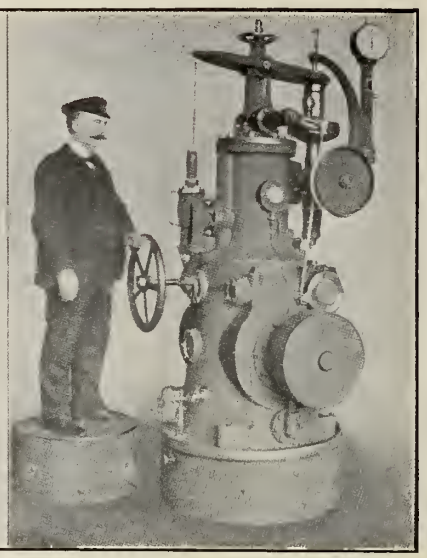


FIG. 18. EXCITER GOVERNOR.

Shut-off valves are fitted on these pipes, as shown in Fig. 19. The turbines themselves are substantially the same as the larger units, but have two bearings only, as shown in Fig. 14. Speed control is obtained by shutter gates, exactly as in the larger machine, and the gates are operated by oil-cylinders controlled by the governor, as before. One of the exciter governors is shown in Fig. 18. As will be seen in Fig. 14, and in some of the other figures, fly-wheels have been adopted on these small turbines, owing to the insufficient fly-wheel effect of the exciter armatures to which they are coupled.

Alternator Features.

The alternators, as before stated, were supplied by Messrs. Vickers, Limited, of River Don Works, Sheffield. They are of the firm's standard horizontal-shaft rotating-field type, and have each an output of 3,000 kw., or 3,750 k.v.a., at 0.8 power-factor. They give 6,600 volts and 60 cycles at 164 revolutions per minute. The specification for the alternators called for a

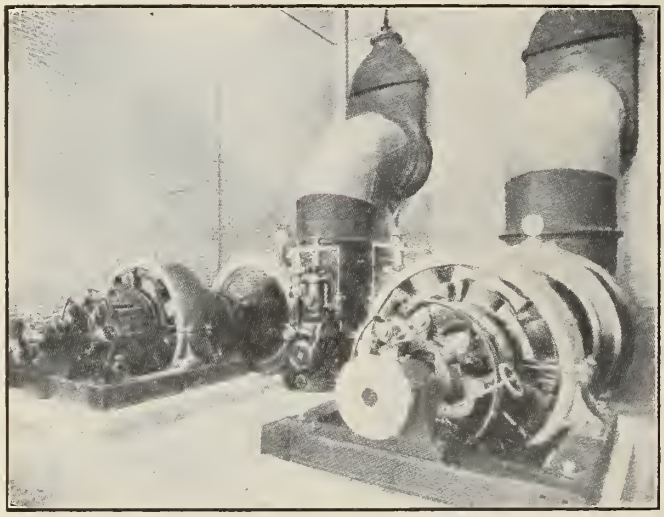


FIG. 19. VIEW OF EXCITERS.

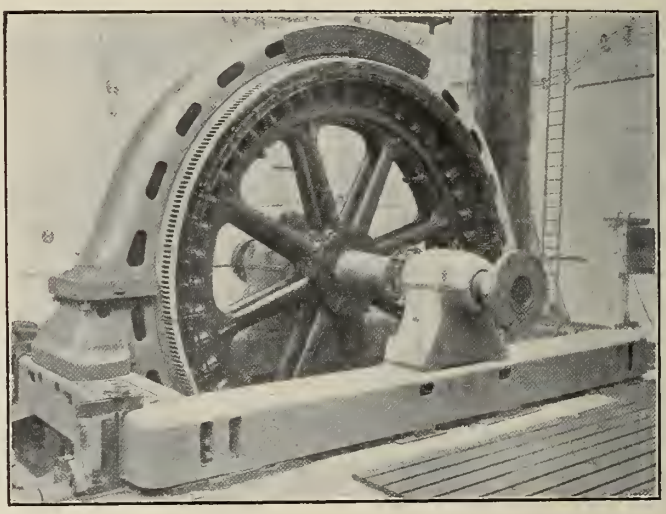


FIG. 20. VIEW OF 3,000 K.W. ALTERNATOR IN BUILDERS' WORKS.

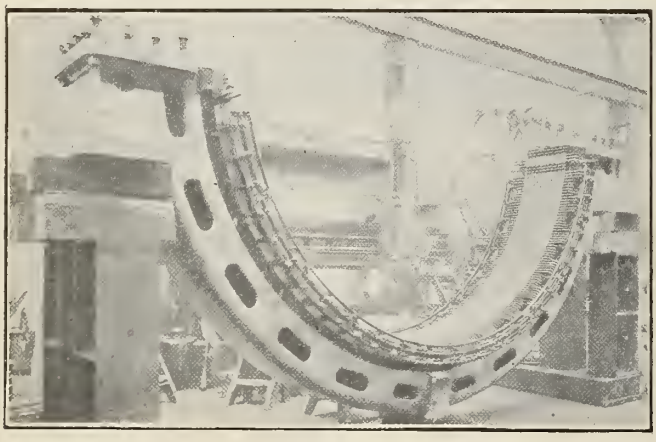


FIG. 21. VIEW OF LOWER HALF OF STATOR OF 3,000 K.W. GENERATOR.

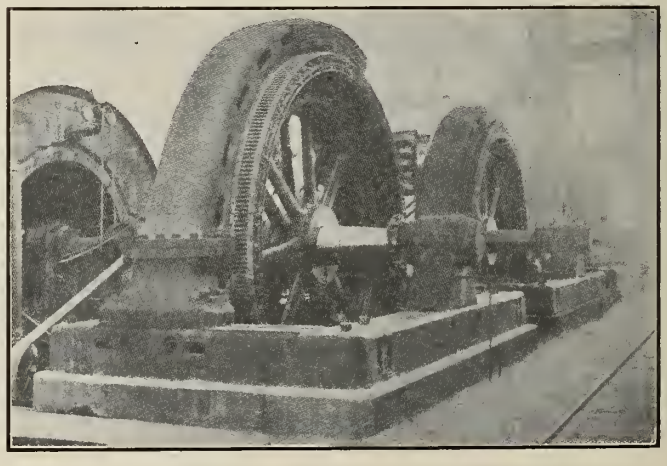


FIG. 23. GENERAL VIEW OF ALTERNATOR ROOM.

temperature rise of not more than 63 deg. Fahr. after 24 hours' full-load run, and not more than 99 deg. Fahr. rise after a 10 hours' run at 3,450 kw. (7,600 volts), and also not more than 81 deg. Fahr, rise after two hours at 3,750 k.w. following the 24 hours' test. All these conditions were easily met by the machines, and as it was found that at full gate the turbines could drive the alternators at greater output than had been specified, a test was made at 4,220 kw., under the conditions of which the temperatures did not exceed the maxima allowed.

The tests also included a runaway speed test for 15 minutes at 70 per cent. over-speed, the field being fully excited. Under these conditions the machine was short-circuited without any signs of injury. The regulation of the machine on test was 8.5 per cent. at unity power-factor, and 22 per cent. at 0.8 power-factor.

Fig. 20 shows one of the machines erected in the builders' works, while Fig. 21 shows the lower half of one of the stators. Figs. 22 and 23 are views taken after the erection of the machines in the power-station. It will be noted from the engravings that the stator frames have been made each in quarters for ease in transport. The figures also show the arrangements which have been made to allow the stator to be racked over for the inspection of the windings or for repair. The stator windings consist of former-wound coils insulated with moulded mica, and secured in their slots by hard-wood wedges. The projecting ends are anchored by mica-insulated bolts and distance pieces, the outer ends of the bolts being fixed to a complete ring which forms part of the guard covering the high-tension winding. The rotors are built up each of two cast-steel wheels pressed on to the shaft and carrying 44 laminated poles, keyed and dovetailed in position. Each pole is wound with bare copper strip on edge, with waterproof insulation between the turns, while bronze wedges are placed between the windings to prevent lateral displacement. Lubrication is by means of oil rings.

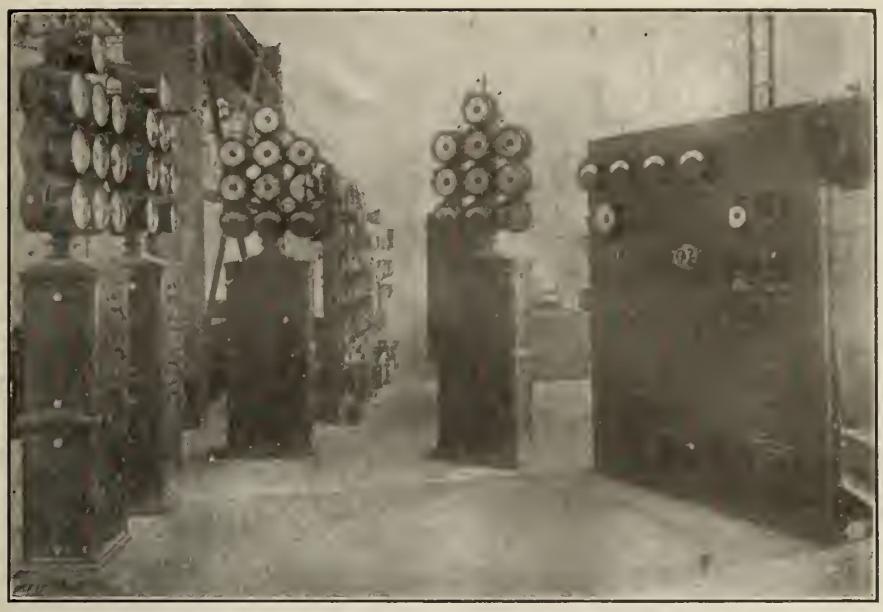


FIG. 24. SWITCH CONTROL PEDESTALS.

The exciters, which are two in number, were also supplied by Messrs. Vickers. They are of the firm's standard eight-pole shunt type, of 250 kw. capacity, and run at 400 revolutions per minute, giving 125 volts. They are illustrated in Fig. 19, and, as this figure shows, are driven by special water-turbines, as before mentioned. The voltage control of the alternators is looked after by Tirrill regulators, which act on the field of the exciters, and are set to compensate for line drop. On the completion of the station, two further exciters of similar capacity with those described above will be installed, but of a motor-driven type. The tests of the alternators and exciters were supervised by Messrs. Kennedy and Jenkins before despatch of the machines from England.

Operating Features.

As already mentioned it is intended that the 3,000-k.w. generators shall ultimately be operated three together, in the

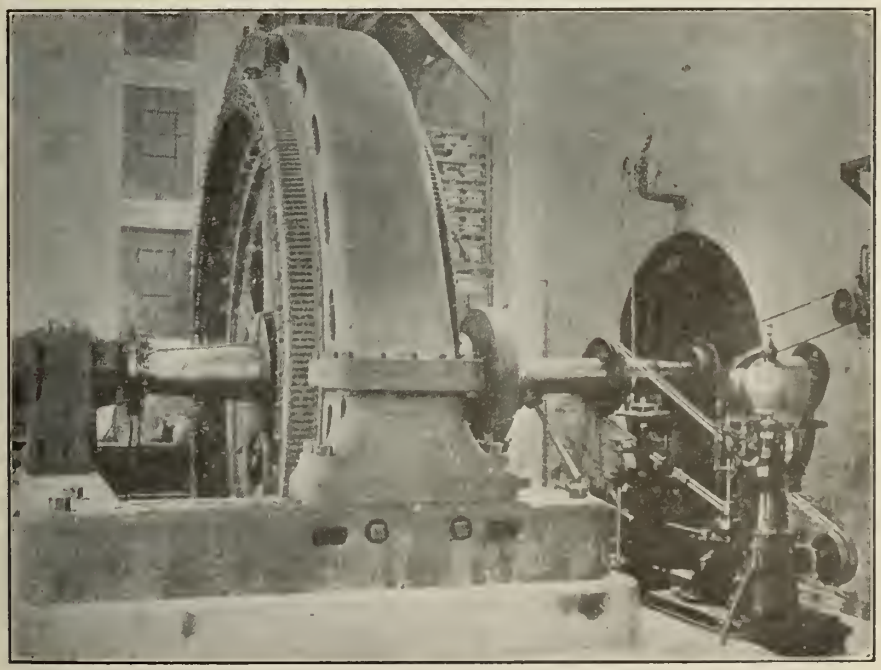


FIG. 22. VIEW OF 3,000 K.W. ALTERNATOR, SHOWING TURBINE GOVERNOR GEAR.

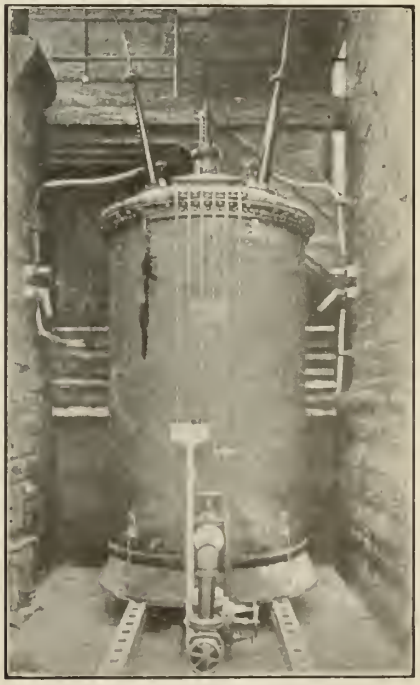


FIG. 27. 3,000 K.W. OIL-IMMERSED WATER COOLED MAIN TRANSFORMER.

form of 9,000-kw. units. The ultimate lay-out of the station as will be seen from Fig. 4, allows for sixteen generators, so that there will be five 9,000-kw. units and one spare generator. At the present time, the whole of the apparatus is fitted for two 9,000-kw. units, with the exception that only five machines are installed. The banks of three machines are

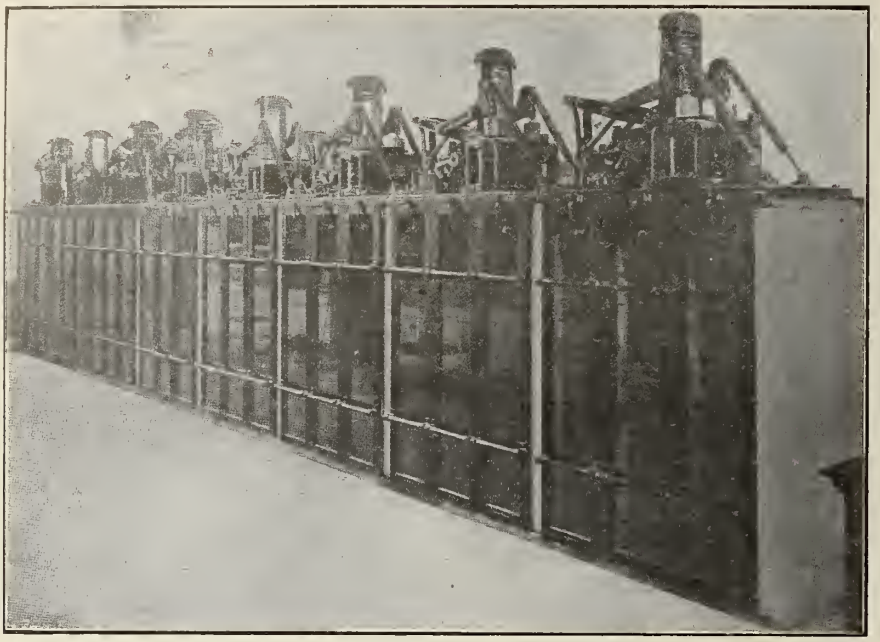


FIG. 25. 6,600 VOLT MAIN SWITCHES.

arranged to work in conjunction with banks of three transformers, each transformer being of the single-phase type and of 3,000-kw. capacity, the three being connected in delta. The transformers are of the oil-immersed water-cooled type, and are situafed in independent concrete compartments which are shut off from the alternator-room by iron doors. The arrangement is clearly shown in Fig. 4. A view of one of the transformers is also given in Fig. 27. The transformer casings are of boiler-plate set on cast-iron bases, and the water-cooling coils are of brass.

Transformer Oil Treatment.

A very complete system for the treatment of the transformer oil is fitted in the station. It consists of filters, a dehydrator, pumps, tanks, and the necessary piping. The oil is received at the station in iron drums, and is at first allowed to flow into the "good" oil tanks by gravity. From thence it is lifted by a pump into a 1,500-gallon supply tank, from which the transformers are filled. "Bad" oil from the transformers is allowed to flow into the "bad" oil tanks by gravity. From these tanks the oil is pumped through a centrifugal-type separator and afterwards through the dehydrator, from whence it enters the "good" oil tanks, to be ultimately pumped into the supply tank. If, however, the oil after reaching the "good" oil tanks is found still to contain too much moisture, it can be passed again, or as often as desired, through the dehydrator before being lifted to the supply tank.

The transformers have an efficiency of 98.7 per cent. at full load, and a regulation of 4 per cent. at 0.8 power factor, and 1.1 per cent. at unity power factor. The temperature rise at full load is 35 deg. Cent. above that of the entering cooling water. The transformers are wound for 6,600 volts on the primary side, and will normally step up on a 1 to 10 ratio; tappings are, however, provided which permit a range of secondary voltage of from 53,000 to 72,000.

Switching Arrangements.

The switching arrangements consist of 6,600-volt oil-switches for both the alternators and transformers, and 72,000,-volt oil switches for the secondary slides of the transformers for the out-going lines and for bus-car coupling. The switches are placed in compartments formed between the banks of transformers, the 6,600-volt gear being on the alternator-room floor level, and the 72,-000 volt gear above. The 6,600-volt bus-bars are in duplicate, and run along the ceiling above the oil-switches. They are of copper strip, and are separated from each other by concrete barriers. The 72,000-volt bus-bars are of $\frac{5}{8}$ in. copper tube, and are carried in a special bus-bar room in the upper part of the transformer compartment of the power station. There are no barriers between these bars; the minimum distance from phase to phase is 4 ft., and the minimum distance from phase to earth 2 ft.

The gear contains the various necessary isolating switches and instrument transformers, and leads are run in connection with isolating switches on the 6,600-volt side in such a way that a transformer in one 9,000-kw. unit can, if necessary, be connected in another. The general lay-out of these switch-gear and transformer arrangements can be seen in Figs. 4 and 5. Views of the 6,-600-volt oil-switches and the 72,000-volt oil-switches are given in Figs. 25 and 26 respectively.

The connections from the outgoing feeder switches to the overhead lines are carried through special compartments, which are built out as annexes to the station, as shown in Figs. 4 and 5. The three compartments for one three-phase circuit occupy a length of the

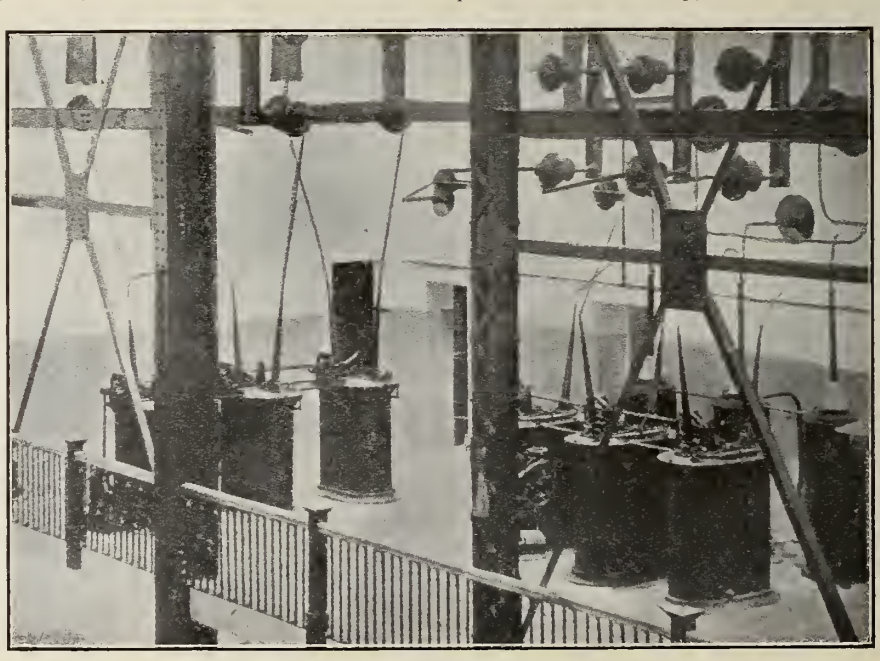


FIG. 26. 72,000 VOLT MAIN SWITCHES.

building which covers two tail-races. This length is actually 56 ft., being somewhat liberal for the apparatus which has to be housed; but the arrangement adopted gives a simple and convenient lay-out. Each compartment is fitted with an electrolytic lightning arrester and horn-gap for its corresponding overhead connection, while, in addition, there is a set of horn-gaps on the roof alongside the wire anchorages. The high-tension wires enter the compartments through reinforced-concrete hoods which are suspended from the outer walls, as shown in Fig. 5. These hoods are open at the bottom, and on the side next to the building have special insulators, through which the wires enter the compartments.

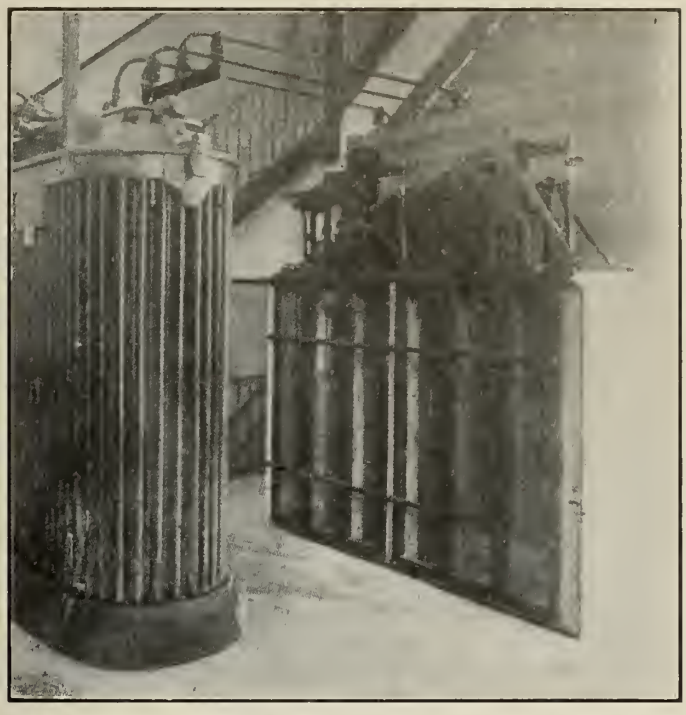


FIG. 28. 300 K.W. OIL-IMMERSED AUXILIARY TRANSFORMER.

Switch Gear Control.

The whole control of the switch-gear is looked after from a control gallery, which occupies what will be a central position in the completed station. This gallery contains the various indicating and recording instruments used, together with the small control-handles of the oil-switches, which are all electrically operated. The machine rheostats are also electrically controlled from this gallery. The instruments and control-handles for the main units are arranged on pedestals, as shown in Fig. 24, in order that confusion between the various sets will be less likely. The control-gallery also contains an exciter-board and gear for the operation of a 120-ampere-hour, 65-cell battery, which is used as a stand-by for lighting or for exciter or auxiliary service. There is also control apparatus for a 300-kw. 6,600 to 250 or 125-volt transformer, which is used mainly for lighting. This transformer is shown in Fig. 28.

In addition to the firms already mentioned in connection with the turbines and alternators, it should be mentioned that the whole of the transformers and switch apparatus were supplied by the Canadian Westinghouse Co., of Hamilton, Ontario. The consulting engineers for the station were Messrs. Smith, Kerry and Chace, while the whole scheme was in the hands of an advisory board appointed by the Winnipeg Corporation, and consisting of Professor Herdt, of McGill University; William Kennedy, Jr., of Montreal; and Colonel Ruttan, of Winnipeg.

A paper read by Mr. W. G. Chace before the Canadian Society of Civil Engineers together with data, photos and drawings supplied by Messrs. Vickers, Ltd., and the Canadian Boving Co., have we understand, contributed to the general completeness of this article, first published by "Engineering" of London, England.

WORLD'S INTERNATIONAL TRADE.

For the year 1912, the world's international business will reach the enormous total of $35,000,000,000, according to a report issued recently by the Bureau of Foreign and Domestic Commerce, Washington, D.C. The estimate is made on official returns of exports and imports from virtually every commercial country in the world. Nearly every nation reported a greater exchange of commodities than ever before had been known.

The new figure will establish a record, for it is four billion dollars greater than the trade in 1910 and more than double that done in 1890, twenty-two years ago. Seventy leading countries furnished their figures to the government statisticians. Only Argentina and Russia reported decreases, both falling off sharply. The United States so far has shown a monthly increase of $18,000,000 over 1911. Canada, Hayti, Honduras and Santo Domingo do most of their shopping in the United States, according to the report, while China, India, certain of the Balkan States and Turkey look elsewhere for their purchases. The balance of trade (that difference of goods sold over those imported) still remains strongly with American manufacturers and producers, the figures showing that they enjoyed a balance on the right side of the ledger of approximately $16,000,000.

A FINE SAMPLE OF CATALOGUE WORK.

THE General Supply Co. of Canada, Ltd., Ottawa, Toronto and Winnipeg, have just issued their first general catalogue—a book of which any supply house might well feel proud. It measures nine by six inches and comprises 1,112 pages strongly and handsomely bound in cloth. In it are very completely listed and illustrated the company's general line of power transmission, elevating and conveying machinery, iron and woodworking machinery, steam goods and miscellaneous supplies. A well-arranged index at the end of the volume enables any particular item to be quickly found. Complete dimension sheets are given covering all standard lines, and these form useful reference tables for architects, millwrights, etc., when laying out installations.

A pleasing feature of this catalogue lies in its being an "All-Canadian" production, having been compiled entirely by the General Supply Co. and printed at Ottawa. Good paper, clear type and high-class illustrations combine to form as fine a catalogue of its kind as has yet been produced anywhere in the Dominion, and all concerned in its production deserve the greatest credit.

Apart from its typographical merits, the catalogue forms a valuable work of reference, not only because of the number and variety of the lines listed, but also on account of numerous useful tables which superintendents, draftsmen, etc., will find of service.

Some Recent Developments in Gas Turbines

By Dugald Clerk, D.Sc.

The accompanying article deals with the experiments which have been made towards the introduction and bringing within the realm of practical possibility for application to power generation purposes of the gas turbine or motor, and shows that while nothing of a really competitive nature has yet been devised, there has been laid a foundation on which may yet be reared a superstructure of valuable mechanical achievement. The data formed part of a paper read before the Engineering Section of the British Association.

ENGINEERS have long recognized that advantages flow from the substitution of rotary for reciprocating movement, and, accordingly, many attempts have been made to produce a gas turbine. So far no attempt has succeeded, the practical difficulties having proved too serious. Much useful knowledge, however, has been obtained by able and adventurous experimenters, and we are now in a position to consider the difficulties afresh, with some experimental data.

Pioneer Records.

Most of the early experimental work upon difficult problems must necessarily be of the forlorn hope type; this is shown by the history of all great inventions. Pioneers should be highly honored by engineers, and one of the names entitled to an honorable position is that of the late M. Rene Armengaud, who, together with M. Lemale, built in 1906 two experimental gas turbines of the constant-pressure type, one of which developed 30 b.h.p. and the other 300 b.h.p. A gas turbine of the explosion type, without compression, was built by M. Karovodine in 1907. It gave 1.6 b. h.p. at 10,000 r.p.m. Recently the explosion type has been studied by Mr. Hans-Holzwarth, who built a gas turbine of a rated power of 1,000 h.p., the wheel of which rotates at 3,000 r.p. m. Mr. Holzwarth has written an interesting book upon his work, in which he discusses the numerous scientific and practical points of the explosion-type gas turbine in a very able and complete way.

Constant Pressure Turbine.

M. Rene Armengaud, in "Cassier's Magazine," of January, 1907, gives an interesting account of his experimental work on the constant-pressure turbine. A small experimental machine was made by altering a De Laval steam turbine of 25 h.p., so as to operate it with compressed air instead of steam. The air was supplied from a high-speed compresser, whose efficiency had been carefully determined. The compressed air was passed into a combustion chamber with measured quantities of gasolene vapor, and the mixture was ignited as it entered the chamber by an incandescent platinum wire. Combustion was maintained continuously at a constant pressure. The combustion chamber was lined with refractory material, ultimately carborundum, and a temperature of about 1,800 degs. C. was maintained at the flame, but the mean temperature of the discharging gaseous contents of the chamber was reduced to 400 degs. C. by the admixture of steam under pressure. This steam was generated in a coil embedded in a portion of the combustion chamber. The working fluid thus consisted of a mixture of products of combustion and steam at the low temperature of 400 degs. C. The constant pressure maintained in the combustion chamber was about 10 atmospheres, and the hot gases were allowed to expand through a conical Laval jet in which the expansion produced a high velocity, and reduced the temperature of the fluid. At this reduced temperature and high velocity, the gases impinged upon the Laval wheel, and rotated the wheel in the same way as steam would have done.

The experiments showed that under these condition, the total power obtained from the turbine separate from the compressor was double that necessary to drive the compressor. In the large 300 h.p. turbine the first part of the combustion chamber was lined with carborundum, backed by sand, but the second part was surrounded by a coil through which water was circulated. The water kept the temperature of the combustion chamber within safe limits, and, after absorbing heat, it passed also around the jet nozzle, and was discharged into the passage leading to the jet, and there converted into steam by the hot gases. A mixture of products of combustion and steam thus impinged upon the turbine wheel. The expanding jet was arranged to convert the whole of the energy into motion before the fluid struck the wheel; the temperature was thus reduced to a minimum before the gases touched the blades.

Notwithstanding this, the wheel itself had passages through which cooling water flowed, and each blade was supplied with a hollow into which the water found its way. In the large turbine, the compressor was mounted on the turbine spindle. It was of the Rateau type, and consisted of an inverted turbine of four stages, which delivered the compressed air finally to the combustion chamber at a pressure of 112 lb. per sq. in. absolute. The efficiency of this turbine compressor was found to be about 65 per cent. The total efficiency of the combined turbine and compressor was low, as the fuel consumption amounted to nearly 3.9 lb. of petrol per brake horse-power hour. This consumption was, of course, much too high to permit of the turbine having any chance as a commercial engine.

An ordinary petrol engine with a moderate compression can readily give its power at the rate of 0.5 lb. of petrol per brake h.p. hour, and even assuming all practical difficulties overcome, so far as running was concerned, a consumption six times that of the ordinary petrol engine for equal power was not sufficiently good for practice. The combined turbine and compressor was stated to have run at 4,000r.p.m., and to have developed 300 h.p. over and above the negative work absorbed by the compressor.

In spite of the high fuel consumption, it was a notable achievement to obtain 300 h.p. from an internal combustion turbine under any circumstances, and had it not been for the untimely death of M. Armengaud this turbine might have been greatly advanced. So far as I know, however, the experiments upon the constant pressure have not been continued.

The Explosion Turbine.

The explosion gas turbine invented by M. Karovodine was exceedingly ingenious. It contained four explosion chambers having four jets actuating a single turbine wheel, which wheel was of the Laval type, about 6 inches diameter, having a speed of 10,000 r.p.m. The explosion chambers were vertical, and had a water jacket surrounding the lower end. The upper portion contained the igniting plug on one side and the discharge pipe connecting with the expanding jet on the other. In the lower water-jacketed part there was provided a circular cover, held in place by a screwed cap. This circular plate was perforated with many holes, and it car-

ried a light steel plate valve of the flap or hinging type. This valve was pulled down by a spring contained within the admission passage. This spring could be adjusted, and the lift of the valve was regulated by a set screw passing diagonally through the water jacket. Air was admitted at one side by one pipe leading into the valve inlet chamber, and a corresponding passage or pipe admitted petrol and air or gas to mix with the air before reaching the thin plate valve. Adjusting contrivances were supplied in both air and fuel ducts.

To start, an air blast was forced through the valve, carrying with it sufficient petrol vapor to make the the mixture explosive. The electrical igniter was started, and the spark kept passing continuously. Whenever the inflammable mixture reached the upper part of the combustion chamber, ignition took place, and the pressure rose in the ordinary way, due to gaseous explosion. The gases were then discharged through the pipe and nozzle on to the Laval wheel. The cooling of the flame after explosion and the momentum of the moving gas column reduced the pressure within the explosion chamber to about 2 lb. per sq. in. below atmosphere. Air and petrol vapour then flowed in to fill up the chamber, and as soon as the mixture reached the igniter, explosion again occurred. In this way a series of explosions was automatically obtained, and a series of gaseous discharges was made upon the turbine wheel.

Diagrams taken from the explosion chamber showed a fall in pressure during suction of 2 lb. per sq. in.; ignition occurred while the pressure was low, and the pressure rapidly rose to about 1 1-3 atmospheres absolutely. The pressure propelling the gas column and jet was thus only 5 lb. per sq. in. above atmosphere. The pressure rapidly fell, and the whole process was repeated again. According to the diagrams taken, about 40 explosions per second were obtained.

Baudezat Experiments.

Mr. Suplee, in his interesting work on the gas turbine, describes experiments made by M. Baudezat on a turbine of this type. The wheel made 10,000 r.p.m. corresponding to a perimeter velocity of 258 ft. per second. At the time the diagrams were taken, the air drawn into the chamber was measured by a meter, and the petrol consumed was also measured. This experiment gave 1.6 b. h.p., and Mr. Suplee takes the wheel and journal friction as 0.5 h.p., so that the equivalent power was 2.1 i.h.p. The fuel consumption was nearly 6.5 lb. per brake horse-power hour. The little explosion turbine thus consumed more than double the petrol required per horse-power as compared with the large constant-pressure turbine.

Holzwarth Gas Turbine.

The large Holzwarth gas turbine operates on the explosion principle, and in general arrangement outwardly resembles the Curtis steam turbine, in that the turbine wheel rotates in a horizontal plane, the spindle or shaft is vertical, and a dynamo is mounted on this spindle above the turbine. In the Holzwarth turbine ten combustion chambers are provided, each of a pear or bag shape, arranged in a circle, round the wheel, and cast so as to form the base of the machine. The wheel is of the Curtis type, with two rows of moving and one row of stationary blades. The dimensions of the wheel appear to be about 1 metre in external diameter.

The action is:—Air is caused to flow through the combustion chamber to sweep out the products of the previous explosion, and also to assist in cooling the wheel by impinging upon it. The nozzle valve is closed, then gas is forced in to produce the explosive mixture. Gas and air valves are both closed, and the electric spark is passed. The pressure of the explosion opens the nozzle valve, and the gases acquire velocity within the nozzle, the temperature falls, and the high velocity lower temperature gases impinge upon the wheel. As the pressure falls, the nozzle valve gradually closes, but remains open until scavenging and cooling current has been passed through. When closed, the charging proceeds and explosions occur, as already described.

Test Results.

Many practical difficulties were found, but ultimately the turbine was operated by producer gas made from coke. When all ten chambers were in operation the maximum pressure on explosion which could be obtained with the best mixture was only about 45 lb. per sq. in. above atmosphere; using five chambers, between 80 lb. and 90 lb.; with four chambers, 105 lb.; the highest power was about 160 b.h.p. In this experiment ten chambers were used, giving 16 h.p. each. With five chambers a total of 145 h.p. was obtained, at 29 h.p. per chamber; with four chambers the total was 121.6 b.h.p. at 34 h.p. per chamber. With ten chambers in operation the power fell to about one-half per chamber, as compared with four chambers.

From these experiments Mr. Holzwarth came to the conclusion that the successive explosions interfered with each other, and prevented proper charging and action. Obviously, with the arrangement used in the experiments, ten chambers were inadmissible. The weight of the whole machine, with dynamo and economizer, with its steam-driven blowers, was 53½ tons, or 120 lb. per brake horse-power total. These weights, after allowing for the necessary gas producers, do not improve upon ordinary reciprocating steam engine weights, including boilers, even on the higher rating, but with the lower power actually found by the experiment, the weight per horse-power becomes impracticably large.

Notwithstanding the unsatisfactory results of these experiments, Mr. Holzwarth is to be congratulated upon his courage and perseverance in attempting to solve a very difficult problem on so large a scale; and his work is not lost, because it supplies much-needed data which will enable either himself or other engineers to attack the problem afresh with better chances of success.

Trade Gossip.

H. Gray & Co., of Montreal, manufacturers of cotton waste and Acme sanitary cotton wipers and mill supplies, have opened a branch in Toronto at 24-26 Dalhousie Street.

N. B. Gibbons, A.M.I.Mech.E., M.I.A.E., has opened an office as a consulting engineer in the new Birks Building, Montreal. Before coming to Canada ten years ago, Mr. Gibbons was connected with Armstrong, Whitworth & Co. and other large concerns. In Canada he has been with the C.P.R., being engineer of tests and later in the president's office. In 1907 he joined the Fairbanks-Morse Co. as manager of the electric and hydraulic department and later took a position with the National Engineering Co. Mr. Gibbons will devote his attention to appraising, mechanical, hydraulic, steam and automobile engineering.

The John McDougall Caledonian Iron Works Co., Ltd., Montreal, have been appointed exclusive agents for Canada for the high speed steam engines built by Browett, Lindley & Co., Manchester, England. The "Browett-Lindley" enclosed, forced lubrication, double acting engines are simple in construction, and, owing to the efficient system of lubrication and perfect balance of the moving parts, run silently and steadily under all conditions of load. The company has made a specialty of building engines for driving dynamos since the earliest days of the electrical industry, and the "Browett-Lindley" is in use in the largest electric light and tramway stations, as well as in the most important collieries, steel and iron works, cotton and paper mills, etc., in England and has earned an enviable reputation for economy and high efficiency.

NOISY SPUR GEARS.

IN an article entitled "Gear Data for Motor Applications," the author, Mr. C. W. Drake, points out that spur gears ordinarily begin to make a noticeable noise at pitchline speed of about 600 ft. per minute, but under average conditions may not become disagreeably noisy with pitchline speeds under 1,200 ft. per minute. The amount of noise allowable depends on the noise made by surrounding machinery, on the character of the workmen, and on the nature of the work in the vicinity. A noise that would be unnoticeable in a boiler shop might be exceedingly disagreeable in a shop that was otherwise comparatively quiet. Where noise is not a limiting feature, there is no limit to allowable pitch-line speeds, except the increased wear and depreciation of the motor, gears, and driven machine; but depreciation may become a very important factor with high pitch-line speeds, say, 2500 ft. per minute, or sometimes even less.

INDUSTRIAL PROGRESS AND ENGINEERING EDUCATION.

Professor W. H. Watkinson, in his presidential address to the Liverpool Engineering Society, alluded to the fields presented by the invention of the internal combustion engine, the dynamo, and the turbine, the development of various systems of marine propulsion, and the adoption of superheated steam. One direction in which the efficiency of internal combustion engines might be increased was by the employment of compound expansion. Several attempts at the compounding of internal combustion engines had already been made; but for various reasons none of them had proved successful. Some preliminary experiments which he had made showed that the compounding of a gas engine with a turbine might be advantageous in connection with large engines.

The introduction of the oil engine for marine purposes, instead of diminishing the value of the coal deposits, might lead actually to a great increase by compelling the utilization of the coal in a more scientific manner by which the tar would be recovered, and the oil obtainable from it employed for power purposes.

Greater value had been attached in Great Britain to the art than to the science of engineering with the result that the Germans were better fitted to develop those branches which were more dependent on scientific knowledge. The high-lift turbine pump was invented by Professor Osborne Reynolds, but German and other Continental engineers had developed it, while British manufacturers had to buy Continental designs of the water turbine. The two-stroke gas engine was invented by Dugald Clerk in 1880, but its development was left to Korting of Hanover, and the application of this cycle to Diesel engines was being developed in Germany and other Continental countries. All the large internal combustion engines, whether gas or oil, built in Britain were constructed to German or Belgian designs, for which British manufacturers had to pay. The application of Diesel engines to marine propulsion had been entirely developed on the continent, the large steam turbine, although first rendered successful by Parsons, had been studied from the scientific point of view in Germany and Switzerland, and an enormous turbine plant for South Africa had been manufactured in Berlin. The application of superheaters to locomotives was almost entirely due to the Germans. Our manufacturing engineers appeared to have been so deeply impressed by the superior knowledge of Continental engineers that they seemed to be afraid of adopting inventions and designs of their own origin.

Engineering Training.

During the last few years he had visited all the principal schools of engineering in Germany, the United States and Canada. In England, the majority of engineers and mechanics had received their scientific training at evening classes, and although this system had produced some of the most capable men, owing to the development of engineering science, it was no longer possible to obtain adequate training in this manner in the higher branches of the profession. When the Americans awakened to the need of better scientific training they went to Germany for their models for the schools.

In the United States, there were in 1908-9 approximately 17,700 engineering students in the principal schools, a number that was more than double what it had been six years previously, and in the technical high schools of Germany there were last session 10,998 students who were taking the regular diploma or degree courses in engineering, shipbuilding, and mining, or, with 5,000 not qualified to take such courses, a total of about 16,000 students. During the last session in the universities and technical high schools of England and Wales there were only 1,623 full-time engineering students, or, with Scotland, a little over 2,000.

Abroad, the employers co-operated with the schools in assisting students to obtain practical training, and in Berlin there was a special bureau for organizing this training which had a list of 500 firms willing to take students into their works. Students in America managed to earn sufficient to maintain themselves while at the university, but English students rarely appeared to have this ability to help themselves. At present the principal difficulty with a considerable number of the latter, was that on completion of their university training their private funds were exhausted and they could not afford either to pay a premium or to undergo two or three years' apprenticeship at the existing scale of wages. This difficulty would be solved by employers giving a more liberal scale of wages to college-trained apprentices.

OBITUARY.

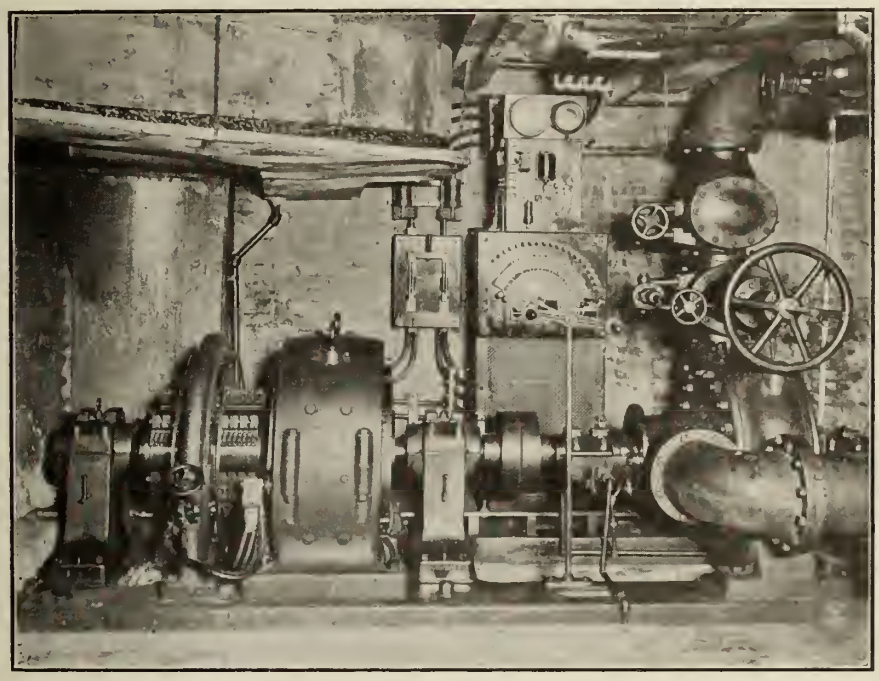
James M. Shanly, one of the best known civil engineers in Canada, died on November 28. The deceased was born in Illinois fifty-five years ago, and came to Canada at an early age. He was educated at Galt Collegiate Institute and the University of Toronto. After graduation he started practising in Montreal. One of the first pieces of work done by the late Mr. Shanly was in connection with the Beauharnois Junction Railway, now a part of the New York Central's road into Montreal. After this, he was chief engineer of the railway which Judge Foster of Knowlton and Mr. Alphonse Charlebois of Montreal undertook to build from Vaudreuil, on the main line of the C.P.R., to Ottawa, and which was afterwards bought by them and incorporated into that system. After 1894, Mr. Shanly was chief engineer of the Baie des Chaleurs Railway, later known as the Atlantic & Lake Superior, and the Central Railway of Canada, first called the Ottawa Valley. He was a member of the Council of the Canadian Society of Civil Engineers, and was also a member of the Engineers' Club.

Charles Weston Leonard.—The death occurred suddenly on Friday, November 22, of Charles Weston Leonard, of the well-known firm of E. Leonard & Sons, London, Ont., and third son of the late Hon. Elijah Leonard. Mr. Leonard attended to business as usual on the previous day. His death was due to heart failure. Mr. Leonard spent his entire life in London, having as a boy attended the public schools, and, later, Upper Canada College. He joined the present firm of E. Leonard & Sons as partner in 1873, and has been identified with the business ever since. Branches of this firm are established from one end of Canada to the other.

INTERESTING ELECTRICALLY DRIVEN PUMP INSTALLATION.

MESSRS. ESCHER WYSS & CO., Canadian Express Building, Montreal, have recently supplied a pumping equipment for the Hydraulic elevators of the Robert Simpson Co.'s store, Toronto, which has some interesting points. The set consists of one Escher Wyss pump designed for raising 1,500 gallons per minute against a total head of 415 feet, coupled direct to a Siemens D.C. 275 H.P., 250 volt, 1,475 to 1,100 r.p.m. variable speed motor. The set pumps into an accumulator until a pressure of 415 feet is reached, then the speed is automatically slowed down to 1,100 r.p.m., at which speed the pressure in the pump drops, and the check valve of the accumulator is closed, whereupon the pump runs idle. As the small clearances between the rotary and stationary parts of centrifugal pumps do not allow same to run for any length of time without water passing through, Escher Wyss & Co. have designed a new form of relief valve, which operates automatically in such manner that as soon as the check valve to the accumulator is shut off, the relief valve is gradually opened, and a small quantity of water passes thereby into a discharge tank, providing a continuous flow through the pump. In this way, damage to the internal parts of the pump is avoided and no water wasted. As soon as the pressure in the accumulator drops to a certain point, the motor is automatically speeded up again to its normal number of revolutions. The power absorbed when running at the lowest speed is about ten per cent. of the normal power.

The pump is of the two-stage centrifugal type with automatic hydraulic thrust balancing device for taking the axial thrust. The runners and diffusors are of bronze, the casing of cast iron, the shaft of nickel steel and the coupling of the flexible type. The motor supplied by the Siemens Co. of Canada is provided with commutation poles, and Siemens two-piece commutator with the brush gear supported in the middle from the bedplate. This arrangement is very satisfactory, as it is essential that there should be no vibration due to the high number of revolutions. Although the current in the motor varies from 90 to 900 amperes, when speeding up from light load to full load, the commutation is absolutely sparkless. This method of pumping in conjunction with a large system of hydraulic elevators is here used, we believe, for the first time, as it is the usual practice to start and stop the set altogether. The idea is that of Mr. A. Kirkaldy, chief engineer to the Robert Simpson Co., and all the work was carried out under his supervision.



PUMPING EQUIPMENT AT THE ROBERT SIMPSON CO. STORE, TORONTO.

Among the various advantages gained by this scheme of pumping are the fairly steady pressure obtained and the fact that the pump generally works at its full capacity, and consequently at high efficiency. As the quantity of water in the accumulator is a little below that required when the elevators are all working, the pump has time to again build up the pressure within the prescribed limits between times when they are not all in operation. A further feature is the saving effected because the motor is not always starting and stopping, but is only slowed down slightly, depending upon the pressure in the accumulator.

The area occupied by the set is very small, as it takes up only about one-sixth of the space required by the usual plunger pumps. The accompanying cut shows the complete outfit as installed.

STEAM TURBINES IN DYE WORKS.

IN works where the dyeing and finishing of textile materials is carried on, and where comparatively large quantities of low-pressure steam are required for boiling and drying, turbine driving offers special advantages. In generating steam in dye works, a common practice is to put down batteries of high and low-pressure boilers, the former supplying steam for power and the latter for manufacturing purposes. In some works high-pressure boilers only have been put into use, and the steam reduced to the necessary low pressure by means of reducing valves. If, in this arrangement, the reducing valve is replaced by a back-pressure turbine, in which the steam required for boiling and drying is allowed to expand to the desired low pressure, great economy can be effected, and, in addition to the plant being highly efficient, power for driving the works is available at a low cost.

LIQUID FUEL.

AT the October meeting of the New York Railway Club, a paper dealing with liquid fuel was presented by W. N. Best. The author stated that liquid fuel is often used with burners that do not thoroughly atomise the oil and evenly distribute the heat throughout the firebox or the charging space of the furnace. A burner should really form a flame to fit the length and width of a furnace as evenly as a blanket covers a bed. It should be capable of atomising fuel of any gravity procurable in the open market without either clogging or carbonizing, no matter whether it be fuel oil of very light gravity or crude oil, oil tar or coal tar. A burner is not worthy of consideration unless it enables the operator to burn any liquid fuel, for no manufacturer should be limited to the purchase of one particular kind of oil.

The author went on to say that a burner should be of such construction that it could be adjusted to make a long narrow flame or a broad, fan-shaped blaze, and each burner should be thoroughly tested so that when it left the shop where it was made, the manufac-

turer would know that it would fill the requirements for which it was furnished. A burner, having the oil orifice below the atomiser orifice and independent of it, renders efficient service because there was no liability of the oil solidifying or carbonising over the atomiser slot at the nose of the burner.

PETROLEUM RESOURCES OF CANADA.

WHILE the actual petroleum resources of Canada are comparatively small, nevertheless the potential resources are considerable.

In New Brunswick and Nova Scotia there are enormous deposits of oil shales which are valuable as a source of oil. On an average, these shales will give a higher yield of crude oil per ton than the oil shales worked so extensively in Scotland.

In the vicinity of Fort McMurray and Fort McKay on the Athabaska River, Alberta, there are enormous deposits of tar sands. The bitumen in the tar sand is the residue from evaporated petroleum, and it has been estimated that there are 6½ cubic miles of solid bitumen in the tar sands exposed on this river. Although enormous quantities of oil have evaporated from this district, nevertheless it is probable that accumulations of petroleum exist where the geological structure was such as to prevent its escape. This is also substantiated by the fact that natural gas occurs in quantity in districts where the tar sands are capped by overlying measures.

If large quantities of petroleum were discovered in Alberta, it would be a factor of great importance to the railway interests which operate in the Rocky Mountains and Jasper Parks, and in other forest areas in British Columbia and Alberta.

Oil as a Locomotive and Marine Fuel.

The Canadian Pacific Railway is now using oil-burning engines on its main line between Kamloops and Field in British Columbia. The Grand Trunk Pacific and some of the Canadian Pacific coast steamships also burn oil, and other boats are being changed from coal-burners to oil-burners. The oil is obtained from the California oil-fields. If supplies can be obtained at the prices now prevailing, its use will be very largely extended. Its cleanliness, the greatly decreased smoke, the decrease in the number of firemen required, the economy particularly in intermittent service, the increased efficiency—two boilers with oil, in steamship service, giving same steam as three with coal—and other considerations, make it an almost ideal fuel.

HEAT AND POWER FROM SAWDUST.

APPLICATION has been made to the city of Vancouver by ten prominent saw-mill owners for a franchise to sell steam heat and electric light and power generated by burning saw-mill refuse. The application came immediately after the report of a committee of the city council dealing with the smoke and sawdust nuisance due to burning mill refuse in the city.

It is proposed to install plants for burning the refuse at each of the various mills, thus permitting a wide zone of distribution and enabling steam heat to be furnished at much lower pressure than from one central plant. The intention is to establish an auxiliary oil-burning apparatus at each mill for use in case of accident to the main plant, and also whenever the supply of refuse runs low.

The problem of disposing of refuse without a loss has confronted mill owners for years, and with coal selling at $7.50 a ton retail in Vancouver, it is thought that this scheme for utilizing it will prove successful. It is estimated that these mills have 114,000 cords of refuse and sawdust to burn each year. The approximate cost of installing each burner is placed at $30,000, and the annual operating cost at $5,000.

NATURAL GAS.

THE gas fields of the Maritime Provinces are being steadily developed. The Maritime Oil Fields, Ltd., has had four drilling plants at work, and is arranging to extend its operations in both Nova Scotia and New Brunswick. This company has already invested over $500,000. The city of Moncton, N.B., is supplied with natural gas at rates that make it cheaper than coal.

WESTERN WATER POWERS.

THE Prairie Provinces' water-powers upon which fairly definite information is available are mostly all confined to the southern portion of each. This is a rather unfortunate coincidence, and is likely to mislead the uninitiated regarding the total potentialities of these provinces, as the larger water-powers are situated in the north, on the Athabaska, Peace, Slave, Churchill, Nelson and other rivers.

As even a preliminary survey of these rivers will be of great value, the Commission of Conservation has undertaken this work. During the last two summers, its Hydro-Electric Engineer, Mr. L. G. Denis, has been in the field making measurements of flow, height of falls, etc., and last year the many rapids of the Athabaska River were investigated and the flow of the Peace and other rivers measured. This year, the work included many long miles of travel, mostly by canoe, the western limit of the trip being the Peace River canyon in the north-eastern portion of British Columbia, while the northern limit was Fort Smith, on the Slave River.

On the return trip, the several rapids and falls in the Clearwater River and the upper waters of the Churchill were investigated. The general impression created by these large northern water-powers is that they will undoubtedly become of great value in connection with the wood-pulp industry. The raw material is close at hand, the only retarding factor, at present, being the lack of means of transportation and access. The details obtained by these investigations will be included in the Commission's forthcoming report on the "Water-Powers of Western Canada."

A LARGE TURBO-ALTERNATOR.

THE Manchester Corporation has accepted the tender of Messrs. James Howden & Co., Ltd., of Glasgow, for a 15,000 kw. turbo-alternator set. The main turbine for this set will be of the Howden-Zoelly pure impulse type, with fourteen wheels, designed to operate at a steam pressure of 200 lbs., with a superheat of 200 degrees F. and 27½ in. of vacuum. The rate of turning will be 1,000 r.p.m., and the diameter of the shafts at the journals 16 in. The main alternator, to be supplied by Messrs. Siemens, is to be totally enclosed, and will embody all the most recent improvements introduced into Siemens' machines. Ventilation will be assisted by fans on the rotor as well as by an external blower.

All air will be filtered by the standard method in use on all the large turbo-alternators installed at Manchester, the air being taken in and exhausted from the top half of the stator frame. The rotor of the machine will be of the solid type, cylindrically wound. The main condenser will be of the "Contraflo" design, and the circulating pumps of the Rateau type, in duplicate, both sets being steam turbine driven. The kinetic air pumps are also to be in duplicate, and each line is to be driven by an auxiliary steam turbine. The weight of the turbine and alternator will be 250 tons, to which the condensing plant will add another 100 tons or thereabouts.

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Vol. VI. DECEMBER, 1912 No. 12

THE SEASON'S GREETINGS.

TO readers of The Power House, we extend the season's greetings and hearty good wishes for a New Year of much prosperity and successful achievement. Our efforts, as in the past, will be directed towards the provision of helpful and interesting matter pertaining to our particular field, and, surely, if the encouragement received during the year now closing be any criterion, there is stimulus enough with which to outstrip all previous editorial records in our 1913 Volume.

POWER GENERATION FEATURES.

THE closing month of 1912 finds Canadian industrial enterprise still in the ascendant, and all evidence pertaining thereto, not only bespeaks its continuation, but declines to set a probable near-future date on which the natural arrest of our country's progress comes due, in order that retrospection may be had of the way along which we have come, and adjustment be made of our individual and collective attitude toward still greater and higher achievement.

Development and progress in the realm of power generation equipment and its application has been in no small measure largely contributory to the attainment and maintenance of the high standard of general manufacturing and agricultural product with which this Dominion now takes a prominent place in the world's commerce, and speaks well for the foresight, intelligence, skill and capacity of those who have planned, completed and are operating the various undertakings, large and small. The harnessing of our water powers proceeds apace, the machinery for which, although as yet, in great measure, the product of other countries, compares in degree of up-to-dateness with that installed anywhere.

The popularity of oil and gas engines for power generation purposes is amply shown by the steady demand for those prime movers by factory owners and municipalities, and, in the new year we look for a considerable impetus being given to their manufacture within our own borders.

The steam turbine continues to develop along the lines of efficiency, reliability and reduced cost of upkeep, and of the trusty reciprocating steam engine, it may be said that it is, as yet, removed a considerable distance from the scrap heap. Makers of power plant auxiliary equipment continue, by their efforts to improve and add to existing apparatus, to contribute in large measure to the general efficiency progress, and in this respect also, we are keeping in the forefront.

Engineers all over the world are devoting increased attention to improving the efficiency of the existing and well known types of steam generators, it being more forcibly realized now than at any previous period, that much scope is afforded for so doing. Oil fuel for steam boiler furnaces is coming into more general use, and were there less uncertainty of supply and cost, we are of opinion that a more general application would soon become apparent.

The whole power field is passing through a transition period, whose end is not yet in sight. It affords opportunity for the keenest observation, and calls for the exercise of all the intelligence we can command, in following its many intricacies, if we would become fully conversant with our profession.

A GOVERNMENT DEPARTMENT OF ENGINEERING.

IN the Province of Ontario there is in existence what is known as a Stationary Engineers' Act, to conform to which, everyone operating a stationary steam plant of 50 horsepower or over, must possess a certificate of competency from an appointed board of examiners. Be it further noted, that the Department of Agriculture is the section of Provincial Government to which this important and almost primary factor in our country's development and progress has been relegated.

Agriculture, manufacturing and engineering, we are frank to admit, are much interdependent on each other, yet there are limits to the extent to which they may be jumbled up. The very idea that stationary engineers, or for that matter of it, any other titled engineers, should be compelled to submit to the indignity of securing a certificate of proficiency from a Government Department of Agriculture is, to say the least of it, preposterous, and it seems to us that while the present condition of things exists, all of the well-meant efforts of those interested in securing a higher standard of competency for the craft, will fall flat.

In the true economy of progress, there is a place for everything, and everything should be in its place, but just how lamentably short this agricultural home and directorship of Ontario's engineering administration falls short of its object, cannot be better exemplified than by referring to the opening sentence of these remarks. Stationary engineers, Union, Association or neither, have every good reason to revolt against, not only the indignity offered in the paltry requirement necessary, but also in the equality basis, by which the Act determines that all operators shall be rated. We are aware that attempts have been made from time to time to have the foregoing disagreeable features eliminated by an Amended Act, which will call for graded certificates, but little, we believe, has been accomplished towards this end, and just as little is likely to be the outcome so long as the present administrative system lasts. A new year of opportunity for engineers is about to dawn, and if they will lay the axe to the root of the tree of their trouble, and assert the dignity of their calling, they will attain their objectives and be acting more in conformity with the status of an honorable profession.

THE ELECTRIC TRUCK.

By L. Ruprecht, M. E.

THE motor truck has made wonderful strides in the past two years. There is scarcely a line of business which has not adopted, at least in part, the horseless vehicle. There are, generally speaking, two types of motor trucks, gasoline and electric. Each type has its particular field, largely because one is more economical in one field than the other. The electric is the city and the suburban truck, while its running mate produces greater dividends in long haul work where few stops and a high rate of speed is desirable. As its title indicates, this paper concerns itself principally with the electric truck, and in common with other electrical apparatus, the early electric truck had an uphill fight. People couldn't or wouldn't understand how it should be cared for, and the result was that a great many pioneer users were dissatisfied, in spite of its simplicity and in spite of the fact that these old trucks are running to-day. They were naturally dissatisfied with their first gasoline touring car with its mysterious complications, but that, as a luxury, was not expected to produce dividends on the investment. The electric truck was expected to, and rightly handled, it finally did.

Durability, Efficiency, Dependability.

The durability, efficiency and dependability of the well-built electric truck is now thoroughly established. There are scores of such trucks in service, which are over ten years old; several thousand that are from three to eight years old, all doing good work. You may have noticed some of these old veterans running about our streets, and they deliver the goods in all kinds of weather at much less cost and with greater despatch than horses.

We all like to make fun of the "one-lunger," but we should not forget that without the first crude model we could never have the perfected machine. It is these "old veterans" running about New York for ten years that have given the electric truck such a boost—that has enabled one manufacturer to put 1,075 electric trucks on these New York streets, principally in the past two years, and 490 heavy electrics into the service of 49 brewers. A business man has but to look at the early model and then at the 1912 product to see the evolution of the electric, and to understand why the pioneer buyers of electrics are putting in "fleets" of from 20 to 150 such trucks.

Universality of Service.

The electric truck is purchased in large quantities by leading merchants, manufacturers and express companies, because, for their work, it is the best paying investment they can make in power wagons. There will, however, always be work that the horse can do to better advantage than the motor truck. You must keep your motor truck busy a large part of the working day in order to get your money back, just as you expect to do with other machinery.

It is generally recognized that 80 per cent. of all average city trucking and deliveries can be most economically and efficiently handled by the electric truck or wagon, and in the matter of cost of operation and upkeep, the electric truck has certain fundamental advantages. In the matter of "fuel" it has a great advantage. Electrics are charged at night when there is little market for current which the power station must "grind out," as it were, regardless of selling it. That's why an electric truck customer gets a rate of from three cents to five cents, or less than half what he pays for his residence lighting. Electric current at four cents is equal to gasoline at ten cents, but gasoline is retailing at sixteen to twenty cents. Electricity is getting cheaper, gasoline prices are advancing. Then, too, the electric truck will last ten years, which means an annual depreciation of 10 per cent., against 20 per cent., or even 33 1-3 per cent. for the non-electric truck. The somewhat slower, consistent speed of the electric means less vibration, less tire expense (the largest single item of upkeep expense), and naturally longer life, and this slower speed, combined with simplicity of control, reduces liability to a minimum. Again, the simplicity of the electric enables a firm to break in regular teamsters, familiar with your conditions, as operators. A driver at $12.00 or $16.00, against a chauffeur at $20.00 or $25.00 a week, is an item of difference of $400 per year in itself. Mention should also be made of about 40 per cent. saved on garage insurance with the electric truck. The advantages just cited are fundamental facts. Your work may require a gas truck regardless of its higher operation and maintenance cost, but if the electric can do the work you certainly have a dozen good dollars-and-cents reasons for buying it.

Electric Truck Mileage.

Electric truck mileages have come in for some criticism in years past, but those who use hundreds of these machines are better judges of what constitutes a good day's work than outsiders. A five-ton electric truck has a mileage of from 35 to 45 miles on a single charge of the battery. The speed is usually seven miles per hour, or over twice the average speed of heavy draft horses, and requires no rest. It is always possible to get 50 to 60 miles per day if you really need it. You can take a "boost" at noon or at one end of a run, or you can equip with extra batteries if more than eight hours' work a day is demanded. Current for a full charge costs, at four cents, an average of $1.25.

Bear in mind particularly that investment in electric truck equipment and garage is very little greater, if not less, than the investment in horse equipment and stable of equal work capacity, and that is so whether your equipment is all electric or mixed electric and horse, or mixed gasoline, electric and horse. The investment when intelligently made pays bigger dividends than most modern machinery and, last but not least, motor trucks will extend your business area. In the heat of the summer, when horses are dropping by the thousands, the electric is there with the goods. You can work it 20 hours a day if necessary, instead of every other day as you do your horses. It is not uncommon for a good electric to work every working day in the year, and I need not remind you that the depreciation of city horses increases each year. A dead horse is a total loss, whether from sunstroke, broken legs or disease. This is an electrical age and the electric truck is part of modern progress. With practically all lines of industry about you adopting it, you cannot afford to lag behind. From a paper read before the Annual Convention of the Eastern Ice Association, New York, November, 1912.

INDUSTRIAL ACCIDENTS.

ACCORDING to the record of industrial accidents maintained by the Department of Labor, there were 104 workmen killed and 324 injured during the month of October. Compared with the record for September, this is an increase of 15 in the number killed and a decrease of 95 in the number injured. The greatest number of fatal accidents occurred in steam railway service, there being 28 employees killed. The building trades come next with 18 fatalities. Of the non-fatal accidents, the greatest number occurred in the metal trades, the number recorded being 85, followed second by building trades with 40 injured, and third by steam railway service with 37 injured.

RAILWAY EQUIPMENT PLANTS.

THE larger locomotive plants are all booked up with orders for some time ahead and it was recently stated that at the present time every Canadian company could have additional orders if they could guarantee deliveries.

Since its re-organization in June, 1911, the Canadian Locomotive Co. at Kingston has turned out 90 locomotives,

20 of them being of the consolidation type for the C.P.R., and 25 of the same type for the Canadian Northern.

In the last year, the Montreal Locomotive Works have turned out 425 locomotives, among which were 108 ten-wheelers for the C.P.R., 60 ten-wheelers for the Canadian Northern, 60 consolidated for the C.P.R., and 75 Pacifics for the C.P.R. At the present time the C.P.R. seems to have orders placed in every equipment and locomotive company in the country, and at the same time is operating its plants on day and night shifts.

The difficulty being experienced by the large Canadian railways in getting deliveries of equipment has also resulted in the new companies getting some big orders to fill, just as fast as they can turn them out.

The new National Steel Car Co., of Hamilton, Ont., have already received orders for 1,500 cars, while the new Nova Scotia Car Works have orders on hand for 2,500 cars.

FUELS FOR INTERNAL COMBUSTION ENGINES.

IN an article on "Fuels for Internal Combustion Engines," by Engineer-Commander A. E. Tomkins, it is stated that a compression up to 220 lb. per square inch can be used for benzol without premature ignition, and, consequently, a slightly higher thermal efficiency is possible than with petroleum spirit, with which a compression of 90 lb. is the usual practical limit. By substituting benzol for petroleum spirit in the ordinary petrol engine, almost all four-stroke cycle engines can be worked at half the existing cost of fuel, but for small engines a special carburetter is required.

Under working conditions, benzol vapor requires 36 to 50 times its volume of air for good combustion, as compared with petrol vapor, which requires 45 to 80 volumes; the carburetter must thus be adjusted to the different proportion to obtain good combustion. Further, the clearance space should be less in proportion, so as to obtain a greater compression, and, therefore, a higher temperature to completely burn the benzol. The greatest objection to benzol as fuel is the price, which, outside very small limits of output as a by-product, would probably become absolutely prohibitive. This point is appreciated when it is remembered that 100 tons of coal yield only 1,000 gallons of tar, which, in its turn, produces only six gallons of benzol. As a by-product in the production of illuminating gas, benzol may be purchased at 12 cents per gallon, but it is easy to see that such a price can only obtain in the absence of any even moderately great demand.

BOILER ROOM ECONOMIES.

By Chas. V. Gamb.

ECONOMY in the boiler room depends largely upon the method of operation, and the success or failure of a steam plant can often be traced to this source. Every individual plant has its peculiarities, which must be studied and every unit in the installation should be kept to the highest possible point of efficiency. In order to obtain the most economical results, three things should be constantly kept in view: First:—The selection and proper use of the fuel. Second:—Maintenance and care of the boilers and setting, and last, but not least, an efficient crew.

Selection of Fuel.

The fuel question, as a rule, is a most important factor, and should have your closest attention. A cheap fuel is not always the most economical, and the only way to find out whether your boilers are doing what they should, or whether the fuel you are using has the heat units claimed for it, is to test them out by means of an evaporation test. A description of boiler tests can be found in almost any good book on boilers, and you can take your choice, and make it as elaborate as you like, but for the purpose of economy, or for the comparison of two different fuels, all that is essential is an accurate way of measuring the feed water, and taking temperature of same every fifteen minutes, for ten hours, weighing the coal and ashes, have a thermometer to observe your stack temperature, and a draft gauge to regulate your dampers. The test should be taken under ordinary working conditions of the plant, but there must be no guess work about the blow-off valves being absolutely tight, and care must also be taken that no undue moisture is carried through the main steam line during the test.

Maintenance Feature.

Having selected the most economical fuel, the next step is to see, that every pound of it is utilized to its utmost capacity. This comes under the head of maintenance, care of boilers and settings. The best results can only be obtained, by keeping the boilers absolutely clean, both inside and outside. Whether the plant be large or small, a regular system of inspection should be constantly kept up. Numerous tests and experiments, conducted by the engineering departments of various universities, show the possibilities of heat losses, due to scale inside of boilers, and that the evaporating capacity of the fuel will be seriously handicapped, according to the thickness of the incrustation, losses running all the way from 9 per cent. to 12 per cent. In many cases this can be entirely overcome, by having your feed water analyzed by a reliable concern, installing a water softener and purifier of the proper size for your plant, and thus, at a trifling cost per day, prepare your feed water, by means of the proper chemicals, in order to eliminate all scale-producing elements before the water enters the boilers. Wash out and clean boilers at regular intervals, and see that it is done in a thorough manner. Keep your boilers well insulated, and protect them from the cooling influence of the outside air. All steam leaks or air leaks, in fact any source of loss of heat should be corrected as soon as possible. Following along these lines, you will not alone have economical results, but you will also prolong the life of your boilers by many years.

Operator Feature.

Next in order is an efficient crew. Of course, the number of men employed and the system to be adopted depends largely upon the size of the plant and the nature of the installation. The enormous size of some power plants calls for various mechanical stokers, overhead coal bins and underground ash removers, with automatic devices too numerous to mention; but in this paper we will confine ourselves to the medium sized plant, hand fired with natural draft. Care and washing of the boilers should be in the hands of a thoroughly reliable man, for, while it is not a very desirable job, it is one of great responsibility, as many times a small defect on the inside of a boiler discovered and repaired in time, will save many dollars.

When there is more than one fireman, rigid rules should be adopted. The fireman coming on duty has a right to expect to find the fires clean, the ash pit empty, and the surroundings as orderly as circumstances will permit; but he must also, in turn, leave it that way for the other fellow. Here is where team work counts. Get men that will pull together, if you are after satisfactory results. Show an interest in the men and their work, and they will appreciate it, if they are the right kind of men; if not, you do not want them. Do not bluster around the boiler room as the big "I am," or as the other extreme, trying to be a "Good fellow" with them; both are wrong. There is a golden middle way, that can only be found by establishing a spirit of co-operation and plant loyalty among the men. Show them by your own actions that it is your earnest desire to bring the plant up to its highest efficiency, and you will find that they, in turn, will take greater interest in the parts assigned to them. You do not expect them to juggle with chemical terms, nor talk about CO_2 or CO, nor B. T. U., but you can and will demand a steady steam pressure, an even water level in the gauge glass of each boiler, a well

regulated and even fire on grates, the dampers set in such a manner as to have an equal draft for each boiler, and the boiler room as neat and orderly as possible.

Last, but not least, let every fireman write his own recommendation, by the quality of the ashes he wheels out to the dump. Insist upon it that those must be ashes, pure and simple, with every ounce of combustible burned out. When you have your men lined up, and all pulling in the same direction, you may be reasonably sure that you are on the right road to economy. From a paper read at the Annual Convention of Southwestern Ice Manufacturers, Houston, Texas, November, 1912.

ELECTRIC POWER SUPPLY OF MONTREAL.

ONE hundred and forty-six thousand horsepower is the amount of electric power now supplied to Montreal by the two principal generating companies who control the business between them, and this amount will be greatly increased in the near future. Of this total amount, the Montreal Light, Heat and Power Co. supplies 121,000 h.p. and the Canadian Light and Power Co. 25,000 h.p.

Interviewed recently, Mr. J. S. Norris, general manager of the Montreal Light, Heat and Power Co., quoted the following figures and power generation locations for the supply of the company's customers:

	H.P.
Chambly (Richelieu River)	20,000
Lachine Rapids (St. Lawrence River)	14,000
Soulanges, Cedar Rapids (St. Lawrence)	15,000
Shawinigan Falls (St. Maurice River)	60,000
Total	109,000

In addition to this, the auxiliary steam stations in and around Montreal supply 12,000 h.p., making a grand total of 121,000 h.p.

Subsidiary Companies.

The various subsidiary companies which own these plants alone, are as follows:—

Chambly, Montreal and St. Lawrence Light and Power Co.

Lachine Rapids, Lachine Rapids Hydraulic and Land Co.

Soulanges, Provincial Heat & Power Co.

Shawinigan Falls, Shawinigan Water and Power Co.

Concerning further developments Mr. Norris said:—"We are employing 650 men at present on the Cedar Rapids. and Power Co.'s plant at Cedar Rapids, St. Lawrence River, and that number will be employed continually until the work there is complete, which we expect will be in January, 1914. It is estimated that the cost will be about $1,000,000. The M. L. H. & P. Co. and the Shawinigan Co. jointly are developing 160,000 h.p. at this point, and that amount will be available when the work is completed."

Canadian Light and Power Co.

Mr. H. R. Mallison, sec.-treasurer of the Canadian Light and Power Co., states that of the total of 25,000 h.p. available, the larger portion comes from the plant at St. Timothee, where it is generated by hydraulic means. The company expects to increase its resources very soon.

National Hydro-Electric Co.

This company is at present operating a small plant at Carillon Falls, about 50 miles up the Ottawa River, and experts claim that there are development facilities up to 150,000 h.p. They have made application to the Quebec Government for permission to enter Montreal with their power transmission lines, but even if this is granted, they will not be in a position to supply power to the city for some time. It was stated by the president that the company proposed to erect a plant which will cost $10,000,000.

HYDRO-ELECTRIC CO. NEW RATE SCHEDULE.

THE following is the new rate schedule in force to municipalities using power from the Niagara system of the Hydro-Electric Power Commission:

Municipalities.	Old rate.	New rate.
Toronto	$18.50	$15.00
London	28.00	24.00
Guelph	25.00	22.00
Stratford	32.00	30.00
Seaforth	41.00	40.00
Mitchell	38.00	37.00
St. Thomas	32.00	29.00
Woodstock	26.00	23.00
Ingersoll	28.00	25.50
Beachville	38.89	31.00
Tillsonburg	32.00	32.00
Norwich	30.00	32.00
Berlin	25.00	22.50
Waterloo	26.00	23.50
New Hamburg	32.00	32.00
Baden	37.00	37.00
Preston	25.00	21.50
Galt	25.00	22.00
Hespeler	26.00	23.00
St. Mary's	38.00	29.50
Dundas	17.33	16.00
Hamilton	17.90	16.00
Waterdown	37.50	26 60
Port Credit	36.70	31.00
Weston	30.00	30.00
Brampton	29.00	25.00
Mimico	30.74	30.00

DISSOLUTION OF PARTNERSHIP.

THE firm known as Vandeleur & Nichols, Dineen Building, Toronto, comprising Mr. J. B. Vandeleur and Mr. R. H. Nichols, is in progress of dissolution. The business has been actively managed by Mr. Nichols for the past few months, and it is his intention to carry on business in the same lines as heretofore.

LEAKAGE TESTS OF NEW CAST IRON PIPE.

By E. G. Bradbury, Columbus, O.

FROM experience with a number of pipe systems, the writer has become convinced that under ordinary conditions of pipe laying, it is improbable that the leakage in a new system will be greatly less than 3,000 gals. per mile daily, unless the same is carefully tested and all defects remedied. By testing in the open trench, under a pressure at least 50 per cent. in excess of the maximum static pressure expected in the pipe, recalking all dripping joints and replacing defective pipe, it is possible to reduce leakage to an extremely low amount.

Reliance cannot be placed on the behavior of the pressure gauge in judging of the tightness of pipe. The gauge may, under certain conditions, drop rapidly when there is no leakage, owing to failure of the gates to close with absolute tightness, or perhaps to air contraction or absorption. It may stand up fairly well to pressure when there is considerable loss, if a large amount of air has become entrapped, and has reached its minimum volume.

Water is reduced by 1|21740 of its volume per atmosphere. Assuming the case of a 6-in. pipe 1,000 ft. long as representing the average section under test, the volume of water contained is 1,470 gals., if the pipe is completely filled. If this water is under pressure, 1470|21740 or .065 gals. must be lost in order that the pressure may drop 15 lbs. Experiments by the writer indicate that 16,000 drops from metallic surfaces are approximately equal to 1 gal. and on this basis 70 drops would necessarily escape from the pipe referred to for each loss of 1 lb. pressure. With first class calking, when the men know the work is to be tested in open trench, the average loss from 1,000 ft. of pipe before testing is about 200 drops per minute equivalent to about 90 gals. per mile per day. By going over the joints leakage may be reduced to a point where there is no visible dropping or escape of water, and pressure can then be maintained for a considerable length of time, if the pipe is free from air.

Air in Piping.

If there is air contained in the pipe, it is often impossible to maintain pressure. This may be due to any or all of the following causes: Air will undoubtedly escape through minute crevices that cannot be penetrated by water. In the compression of air, heat is generated, expanding the air, and in the cooling process following, the air necessarily contracts and a loss of pressure results. To what extent this takes place in the comparatively slow process of increas-

ing the pressure in a pipe test, or, in other words, whether all of the heat is radiated during the process of compression, is not known, but in view of the fact that air compressed to 150 lbs. and not cooled, is increased over 500 deg. F., and has a volume practically double that of the same air under the same pressure after cooling, it is possible that some slight action of this nature may occur.

Further, as the pressure is thus reduced, the natural tendency is for the air to lose more of its heat, inducing further contraction. It is also probable that there may be an absorption of the elements of the air by the water. The amount of gas absorbed by water, at a given temperature, is a function of the volume, regardless of pressure, and the weight of gas absorbed is therefore proportional to the pressure. Variation of temperature also effects absorption. A very complex action must necessarily result from these conditions, but the general tendency of the several factors is in the direction of reduction in volume of the pipe, with consequent loss of pressure. It is never possible to maintain pressure in a test made immediately after filling the pipe as well as can be done a few hours later. This is undoubtedly partly, and in some cases wholly, due to the absorption of water by the yarn in the joints, but if air is present it often contributes to the trouble.

Pressure Gauge Results.

In reports descriptive of tests of this nature, there appear frequent references to the difficulty of obtaining anything like uniform results with the pressure gauge, and the loss of pressure often observed where no leakage is apparent is the occasion of considerable surprise. The writer is convinced that if all air is excluded from the pipes and all joints kept visible during the test, this phenomenon will disappear. Owing, however, to the difficulty of getting rid of the air, this is not always feasible in practice. Excellent results may be obtained, regardless of the behavior of the gauge, if all parts of the pipe are inspected under pressure and all visible leaks stopped. This method also eliminates possible trouble for minute gate leakage.

Data From Water Distribution System.

During the summer of 1911, the attention of the writer was particularly called to the subject of this paper by his connection, as designing and supervising engineer, with the water distribution system of the village of Grandview Heights, Ohio, a suburb of the city of Columbus. An arrangement was made by this village to purchase filtered water from the Columbus water works at a net price of $1.20 per 1,000 cu. ft. The necessity for the tightest possible work was obvious, and specifications were drawn requiring that all pipe be tested in the open trench, under a pressure of 150 lbs., to the satisfaction of the engineer. The system comprises 5,719 ft. of 12-in. pipe, 7,701 ft. of 8-in., 16,508 ft. of 6-in., 75 valves, 36 hydrants and 2 air valves. Every section of pipe was tested and gone over until no evidence of leakage was visible with all pipe exposed. The record of tests shows that in many cases gauge pressure could not be held, though every pipe and joint was in plain sight and no leakage could be located.

A number of observations of the water entering the system were made by means of a 1-in. meter. Two service pipes were connected with the system during these tests. The amount passing the meter varied, the minimum being 10 and the average 25 cu. ft. per day. It is perhaps not unreasonable to assume that the minimum metered quantity for one day expresses the leakage from the system, but the average figure was taken. The working pressure on the system varies from 45 to 90 lbs., averaging about 65.

On the completion of the system, a 6-in. meter was installed at the Columbus water works pumping station for the measurement of all water sold to the village. This meter was new and was carefully tested by the city department, and stated to register accurately down to the smallest stream provided by their testing apparatus, namely 1-32 in. It is, however, probable that there would be some under-registration in case of very small flow. During the first month's operation but two services were connected, and the quantity of water registered by the meter was 600 cu. ft., equal to a little less than 27 gals. per mile per day, including whatever may have been used by the two consumers. Soon after this, 80 taps were added. After an interval of about two months, the city meter and all individual meters were read. The amount of water passing the 6-in. meter for the period of 58 days was 46,000 cu. ft. and the sum of the readings of the house meters was 39,300 cu. ft. During this period an extension of 550 ft. was made and water was used to settle the trench to amount of 1,200 cu. ft., leaving a quantity unaccounted for of 100 cu ft., or 2.3 gals. per day per mile. The amount of water supplied to the village was equal to 17.5 gals. per consumer per day, figuring on the average number connected for the entire period. The population is suburban, and the use purely domestic. The writer believes that few complete systems have been installed with as low a leakage.

The value to this municipality of a tight system is, of course, much greater than to cities pumping their own water, the net cost of water being slightly over $.16 per 1,000 gals.; for each 1,000 gals. per day per mile lost, the actual cost is about $320 per year, which, capitalized at 4 per cent., amounts to an investment of $8,000, or, in other words, if the system had a leakage of 1,000 gals. per day per mile (which is considerably below the probable average in similar systems) the village could afford to spend $8,000 if, by so doing, the leakage could be reduced to the present amount.

Value of Tight Water Pipes.

The value of tight water pipes to a city pumping its own supply is less readily computed. Fixed charges, attendance, etc., are not materially affected by moderate leakage, except as additional capacity is required at an earlier date. The fuel bill, and, in case of treated water, some items of the cost of purification, are chargeable in proper proportions to such leakage as may exist. It may safely be stated that the cost of careful inspection and testing is always more than justified by the saving that can be accomplished.

Permissible Leakage.

Regarding the amount of leakage permissible in new work, general practice would appear to justify anywhere from 60 to 250 gals. per day per mile per inch of diameter. Loweth proposes 60 to 80 gals. per inch-mile. The writer is of opinion that except under particularly unfavorable conditions, it is possible to reduce the loss to a very low figure—so low indeed as to be almost negligible. Open trench testing, as above described, and rigid insistence on the closing of all visible leaks will accomplish this result, and by no other means can it be done. It is better to specify this test than to state figures of permissible leakage, as results far better than one would feel justified in specifying are possible, and it is impossible to demand better work than required by the specifications. From a paper read before the Ohio Engineering Society.

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Mr. Thv. Heyerdahl, chief engineer in Canada for Escher Wyss & Co., Zurich, Switzerland, is severing his connection with the firm's Canadian organization and will leave Canada at the end of the present year.

Mr. Th. Seidl, previously in Charge of the engineering department at the company's London office, will succeed Mr. Heyerdahl.

The Hare Engineering Co., Ltd., Toronto, have secured the Canadian rights for the manufacture of the Fulton stoker, and are at present installing units of this machine at the plants of the Canadian Billings & Spencer Co., Welland, and Meaford Brick Co., Meaford, Ont.

ELECTRICITY AND HYDRAULICS

This department is intended, in addition to individual treatment, to feature the close relationship existing between electricity and hydraulics in the power and light field.

HIGH-LIFT CENTRIFUGAL PUMPS.

CENTRIFUGAL pumps are used for almost every conceivable duty, some dealing with 60,000 gallons per minute against low heads of 10 ft., and others with 2,000 gallons per minute against heads of 2000 ft. It is not advisable to instal centrifugal pumps when a small quantity of water is to be raised against a very high lift, as it is impossible at present to build a pump of this type having such an efficiency as would warrant its preference to that of a reciprocating type. There is no hard-and-fast line dividing low lifts and high lifts. This feature applies rather to the design, for it sometimes happens that the high-lift type of pump is used for quite low lifts.

A pump which is or can be easily transformed into one in which the full head is impressed upon the water in a number of stages arranged in series, so as to form a self-contained machine, is usually said to be of the high-lift type. This type of pump is sometimes called a turbine pump, and is also known by various trade names, but in principle they are all the same, and, to prevent confusion, all pumps in which energy is given to a liquid as it flows in a more or less radial direction through a rotating impellor should be called centrifugal pumps.

Machining.

It almost goes without saying that reliability cannot be obtained unless proper attention be paid to the machining of all parts, and that all rotating parts be correctly balanced to prevent vibration when running. Many of the failures of the early high-lift centrifugal pumps can be traced to faulty machining. One of the greatest difficulties in securing reliability is the balancing of the axial thrust produced by the impellers when the pump is running, and in pumps in which the axial thrust is balanced automatically by an endwise movement of the shaft, it is necessary that they should be coupled to the driving motors by a coupling which allows a certain amount of axial flexibility. Failing this, it must be possible for the rotor of the motor to move endwise. It is necessary, also, to have some parts of the rotating elements running with a small clearance from stationary parts to prevent leakage of high-pressure water into a low-pressure space, and it is clearly an advantage to have these as few in number and as small in diameter as possible, especially in pumps dealing with water containing grit.

Stuffing Boxes.

Stuffing-boxes, especially those under pressure, are to be avoided as much as possible. They mean that more friction has to be overcome, and often cause excessive wear of the shaft. When working under pressure, there have been instances of water leaking past them and along the shaft into the bearing and floating the oil out of the latter. These difficulties led me to design a pump in which stuffing-boxes at the delivery end were dispensed with, and necessitating the use of some form of internal shaft bearing, so designed that the water with which the pump is dealing cannot pass along it. This bearing has a closed end, and no water can pass along from the balancing chamber. A grease lubricant, after traversing the whole length of the bearing, passes into the balance water. The water used for balancing flows round the outside of the bush, thus forming a water-cooled bearing. Not only does this type of bearing dispense with a stuffing-box, but it allows a much stiffer bearing to be brought close up to the rotating impellers than is the case when an external bearing is used. This internal bearing has in practice proved quite reliable even when running at high speeds.

In pumps which drive through the suction end, it is necessary to have a stuffing-box working with a partial vacuum on the pump side. Unless special precautions are taken, air will be drawn into the pump with the risk of losing its water. The usual practice is to arrange some form of water seal, in which water is taken from one side of the first impeller and led into a groove in the neck bush, and when running, the gland should be left sufficiently loose to allow a slight drip of water, showing that the water seal is operative, and that no air is being drawn into the pump. It is not, however, always advisable to seal the stuffing-box with the liquor which the pump is handling, as, for instance, in the case of a pump dealing with a liquor which would have an injurious effect upon the packing and the shaft running in the packing. In cases such as this a separate supply of water is led to the neck bush by external means. Another point of design which increases the reliability is that no small screws or similar fixings should be employed inside the pump. They are liable to work loose, due to vibration and water getting to the threads and corroding them. All parts, such as the guide passages, should with advantage be held in place by the main bolts of the pump.

Total Head Feature.

Before ordering a centrifugal pump, care must be taken to see that the total head, including suction and delivery lifts and friction head, is correctly estimated. This is particularly necessary if a pump is to be driven at a constant speed, as when an alternating-current motor is used for driving. In medium-sized motors it is usual to allow a 20 per cent. margin in power. The size of suction and delivery pipes depends upon what is considered the most economical friction head in each case. This head increases approximately inversely as the fifth power of the diameter of the pipe, and when dirty water is being handled, due allowance should be made for the pipes becoming coated on the inside. The question of the speed and number of stages of the pump to ensure reliability is one best left to the maker, for, obviously, when dealing with clean water, much greater speeds are allowable without undue wear inside the pump taking place than when the water is charged with solid matter in suspension.

Suction Lift.

A centrifugal pump will, generally speaking, deal with as great a suction lift as a reciprocating pump, but, nevertheless, it is advisable to place the pump as near the source of supply as possible, for the less the suction the less the liability to air leakage. With hot liquids, the permissible suction lift is much reduced. The suction pipes should be laid

with a rise towards the pump throughout the entire length, to obviate air accumulating at any point. A valve, preferably a sluice valve, should be placed in the delivery main, as close to the pump as convenient, and for high lifts it is also advisable to fit a non-return valve in the delivery main. This prevents the column of water falling back on the foot valve, as there are no valves in the pump itself, and causing dangerous water hammer shocks in the pump if it be suddenly stopped. Some method of priming or filling the pump with water must be provided. This is usually done by allowing the water in the delivery column to run back past the delivery valve into the suction pipe, the pump forcing out the air through an air cock, fitted on its highest part. Should there be no water available in the delivery column, the pump must be filled by hand or from some external water supply, or an ejector fitted to draw out the air and allow the water to rise up the suction pipe into the pump.

Starting-up.

In starting up a centrifugal pump, after seeing that the bearings are in order and that the pump is fully primed, the delivery valve should be closed and the pump run up to its proper speed. The delivery valve can then be slowly opened until the pump is discharging its full quantity. The conditions imposed upon a motor in starting up a centrifugal pump are quite light, as the power required is practically nil at very low speeds, and gradually increases as the speed increases, reaching a maximum when the pump is running at its normal speed with the delivery valve closed. Should it be necessary to reduce the quantity delivered by a pump when running under normal conditions, it is advisable to do this by partially closing the delivery valve, or, in other words, by slightly increasing the head on the pump. This is quite an economical method of regulation. The quantity can be decreased by decreasing the speed of the pump, but this is by no means so reliable.

If due attention be paid to these points, centrifugal pumps can be obtained which are quite reliable in operation, but such pumps are not necessarily the cheapest in the first place, though they prove to be so in the end. It is, however, hardly possible for a maker to turn out a pump which will give complete satisfaction unless it is installed, run, and treated with the care due to a high-class, high-speed machine. Being pumps, by the very nature of things, the conditions under which they have to work are usually severe enough at the best without making them worse by inattention. From a paper by W. E. W. Millington, Manchester Association of Engineers.

LARGE ELECTRIC METER.

A LARGE watt-hour meter to be installed for the Hydraulic Power Co., Niagara Falls, will be capable of measuring 60,000 amperes at 650 volts, equal to about 50,000 horsepower. The meter, which is of the mercury type, is being constructed by the Sangamo Electric Co., Springfield, Ill., and is believed to be the largest ever built. It is to be employed in connection with the measurement of direct current used in the production of aluminum.

MERCURY VAPOR RECTIFIERS.

THE Electrician mentions that formerly about 50 amperes was considered the limiting output for mercury vapor rectifiers, but that with the newest equipment an output of over 700 amperes has been reached. In all the earlier types, use was made of a lower negative electrode of mercury held within a glass envelope, through the top portion of which were inserted two or more positive electrodes, which in operation became active successively. Numerous mechanical and thermal causes, including expansion, leakage and temperature elevation phenomena, tended to limit the permissible output to from 30 amperes to 50 amperes.

In the latest form, use is made of a metal envelope, through the top of which the positive electrodes are inserted by way of porcelain tubes. The different parts are subjected to artificial heating according to the amount of heat produced locally. As a connecting link between the alternating-current supply system and the continuous-current motors, the synchronous converter is not well adapted by reason of well-known mechanical and electrical limitations. However, the latest form of mercury vapor rectifier is light in weight, small in size, requires little attention, and can be regulated with the maximum of simplicity. The control apparatus can be exclusively of the simple variable potential alternating-current type, which is far cheaper than either alternating or continuous-current control equipment.

MATERIAL AND PRESERVATION OF POLES.

A WRITER in the Electrical Times recently stated that probably the best wood for poles is cedar, but chestnut also makes excellent durable poles. Much depends, however, on the nature of the soil, and, generally speaking, native timber will be more durable than poles of otherwise equal quality grown under different conditions of soil and climate. In England, the life of well-seasoned creosoted poles is about thirty-five years in good soil and from eighteen to twenty in poor soil. In America, where untreated poles are generally used, the average life is about twelve years.

The creosote treatment is the best for protection against decay, and there are three recognized methods of applying it: (A)—The high-pressure treatment; (B)—the open tank treatment; (C)—brush treatment. The first is the best but most costly, while the second if properly carried out gives very good results. When poles, otherwise sound, have decayed at or near the ground they may be reinforced by means of steel rods, about ½ inch diameter, pointed at both ends, and driven into the pole above and below the damaged portion. Concrete is then fitted in around the poles extending at least 12 inches above ground level. The cost may be from $3 to $4 per pole, and the life may be prolonged five to ten years.

AIR COMPRESSORS.

A PAPER on Air Compressors, read before the Manchester Association of Engineers recently, was offered with the idea of considering the reason why compressed air is accepted as an inefficient means of power transmission, as well as to show what had been done by manufacturers to improve this class of machine without any considerable pressure having been brought to bear on the subject by users.

The author said that very inefficient plants exist, and exist in large numbers, and are still being laid down. Why was this? Was it simply because it is thought nothing but inefficiency can be expected? Why not have the same strict specification applicable to air compressing plants as has been the rule for electric generating plants? The only reason which can be put forward why such a course was not adopted, would seem to be, taking a wide view of the matter, that few engineers had given much study to compressed air, and had taken it for granted that what had been, must still continue.

Looking at the matter from this standpoint, we found that, in inquiries issued for large compressors, the capacity of machine was given. If steam driven, steam pressure and vacuum were mentioned, and, if electrically driven, voltage. It might be, but it was not general, that steam consumption was asked, and on a very rare occasion a capacity test was called for. Such a test when made was seldom, if ever, any check on the output of the machine; the test generally being to fill a reservoir of given capacity from atmospheric pressure to final working pressure.

REFRIGERATION DEPARTMENT

DRY BLAST REFRIGERATION.

A NEW method of drying the air for blast furnaces by the aid of mechanical refrigeration has been perfected and is being introduced by the inventor, Charles H. Leinert, Chicago, Ill., says "Ice and Refrigeration." As an evidence of the merit of his apparatus, the inventor states that contracts have been concluded with representatives of the Krupp gun works, Essen, Germany, for installation of plants at two of their blast furnaces, with option for control of the system in Germany if practical operation proves the method to be as effective and economical as is claimed. The Illinois Steel Co., South Chicago, Ill., has secured the right to use the system for its blast furnaces. Patents covering the method and system of application have been granted in the United States, Germany, Austria, France and Luxemburg.

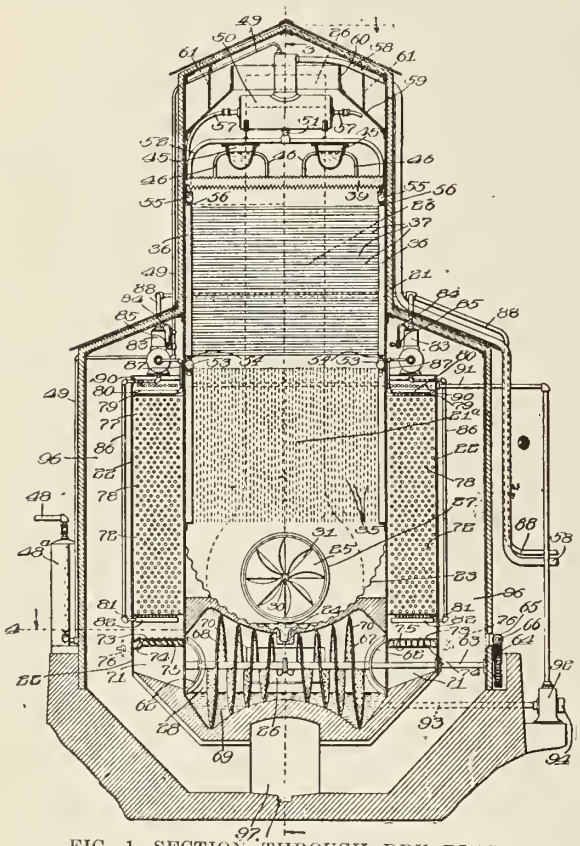


FIG. 1. SECTION THROUGH DRY BLAST AIR COOLING DEVICE.

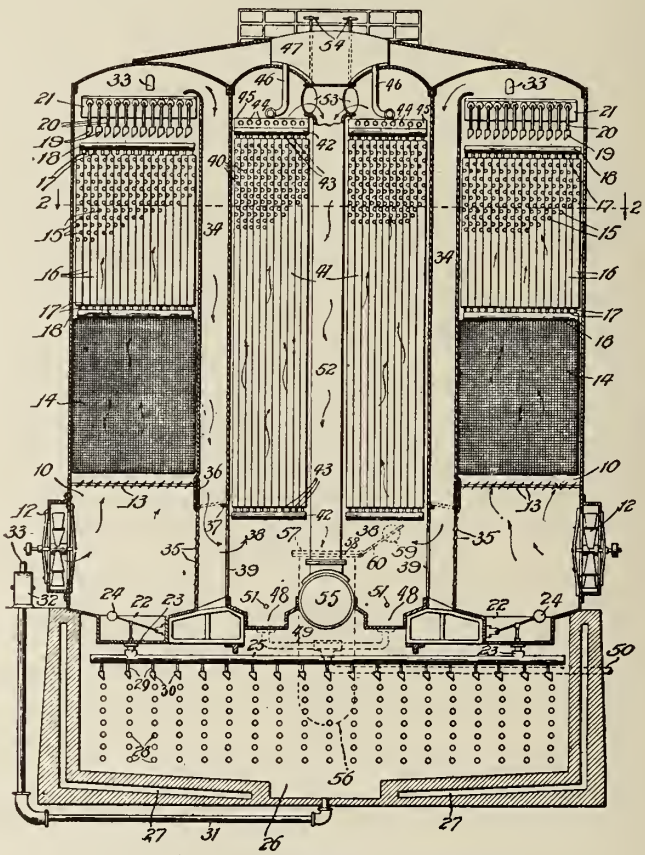


FIG. 2. PREFERABLE ARRANGEMENT FOR AIR DRYING SERVICE.

In this new system, the air intended for the blast furnaces is first introduced into a cooling tower by means of rotary fans which force it upwardly through a spray of water trickling over screens or chains; the water having been previously chilled by passage over ammonia pipes or overflowing from a tank in which direct expansion pipes are immersed. The spray serves to remove mechanical impurities, such as soot, etc., cools the air to about the temperature of the water and robs it of a large portion of its moisture content.

From this preliminary cooler and dryer, the air passes through a passage at base of the cooling tower in which a spiral, made with expanded metal or similar material, rotates. This passage, or chamber contains in its lower part a concentrated solution of calcium chloride or other deliquescent re-agent which adheres to the surface of the expanded metal as it rotates, and thus further dries the air to about two grains per cubic foot, during its passage through the spirals. Two spirals are used, as may be noted in the illustration and these revolve in opposite directions. Air admission is at the centre, the revolutions of the spirals driving it to either side.

Leaving this chamber, the air passes upwardly through a pair of chambers containing a large number of direct expansion pipes in which liquefied refrigerant, such as anhydrous ammonia, expands. As the air is already robbed of much of its moisture, comparatively little remains to be deposited in the shape of frost upon these pipes, and this deposit is prevented by causing a thin film of calcium chloride brine to trickle down over the pipes. By its passage over these, the air is deprived of its moisture to within one or one and a half grains per cubic foot. From this final drier the air passes into the intake pipe of the blowing engines and thence to the blast furnace stoves where it is heated to about 1,500 degs. F., ere it is admitted in to the blast furnace.

The cooling tower, it is asserted, occupies much less space than the air drying plant heretofore used, and can be locat-

ed conveniently on the roof of the building containing the blowing engines, or otherwise in close proximity to same. It is more economical to carry the liquefied ammonia to the tower than to conduct the very much greater bulk of air from the refrigerating plant to the blowing engines. Moreover, there is no stoppage of any part of the apparatus for the removal of frost accumulation on pipes.

The water which trickles through the preliminary drying chamber collects in the bottom of same, and is pumped back to the troughs in the upper part of the chamber, or to the tank fitted with ammonia coils. As additional water is condensed from the air passing through this chamber, the surplus water is conducted through suitable pipes to the ammonia condensers, and on account of its low temperature, effects a considerable saving in the operation of the condenser.

Modified Method Apparatus.

A modification of the method and apparatus for air blast drying by means of refrigeration is illustrated in Fig. 2. By the arrangement there shown, the penetration of outside heat to the final cooling chambers is effectually prevented by placing these at the centre, and placing the preliminary coolers and air purifiers at the sides. Referring to Fig. 2, air is driven into the preliminary cooling chambers (10), by means of rotary fans (12). Above the air chambers are a series of screens, or chain plates (14), which serve to sub-divide the cold water descending from above, so that as large a surface of water as possible is exposed to the action of the air which passes upwardly. Above the screens are a series of pipes (15), connected with vertical pipes (16), which are in turn connected with horizontal headers (18). The headers (18) and pipes (16) may be supplied with liquid ammonia, cooling the pipes (15), over which the downpouring stream of water from troughs (19) and tank (21) flows. The water thus pouring down through the cooling tower is collected in a cement water reservoir (26), below the cooling tower. This reservoir is provided with pipes containing liquefied ammonia, over which the water is sprayed through troughs (30) from pipe (25). The water thus cooled is drawn off through pipe (31) by pump (32) which returns the water to top of cooling tower to be used over again.

The air leaving cooling tower at top, as indicated by the arrows, flows down the passages (34), and enters the final cooling chambers (38) at bottom through opening (39). These cooling chambers are supplied with direct expansion piping (40) (41) and horizontal headers (42). Just above the headers are pipes (44) (46) communicating with tank (47), containing calcium chloride brine, which, passing through slits in pipe (44), falls in a thin film over pipes (40) and prevents the accumulation of frost on said pipes. The Ca.Cl. brine collects in troughs at bottom of chamber, and through pipes (49) and (50) is pumped back to tank (47). An overflow (51) serves to lead the calcium chloride to a concentrator when the solution becomes too dilute. Regulators are provided for controlling the flow of the cold dry air from final coolers to blowing engines, to which it passes through pipe (55) and blowing engine intake (56).

Suitable provision is made for cutting out the preliminary cooling tower when desired, for which purpose, louvres (35) are placed in wall of preliminary cooling chamber, the opening of which sends the air directly to the interior final air coolers. Thus, when the outside temperature is above 40 degs. F., the air is passed through both preliminary and final coolers. If temperature is between 20 and 40 degs. F., the air is passed only through final cooling chambers, and if outside temperature is below 20 degs. F., the cooling tower is entirely cut out and air admitted directly to intake of blowing engines. Broadly speaking, the novelty in this new method consists in the use of preliminary cooling, and final cooling and drying means.

READER, WHAT DO YOU KNOW?

Among readers of The Power House there is a clearly defined sincerity of desire to know how each overcomes the daily problems arising out of the care and operation of the power plant. It is believed that your methods of solving these are valuable, and can be made more so, if you publish them, so that other brains may help in the work. We will provide the setting and pay you for the material. When your fellow engineer puts the super-structure on your foundation, we pay him and pass the "kink" on to you, free. Get into the game.

APPLICATION OF CO_2 TO REFRIGERATION.

At a recent meeting of the Junior Institution of Engineers, a paper was read by Mr. A. H. Tyler on "The Application of CO_2 to Refrigeration," in which he cautioned those reading up the subject to carefully investigate the basis of all published data. Figures bearing the name of Dr. R. Nollier, he said, could be trusted.

The title of CO_2 was examined, also the source of supply, and who the chief consumers were. It was pointed out that CO_2 has much to recommend it as a refrigerating medium, as it is inexpensive, generally obtainable and safe to handle, being inodorous and harmless. The specific gravity of CO_2 was touched upon, and a table of the properties of CO_2 (Carbon Di-Oxide) was given; the critical temperature being dealt with fully; a further table was also quoted.

A diagram of the entropy of CO_2 was shown, and the factors that go to make up efficiency and range were given. In describing the types of compressor and efficiency, several tables and figures were referred to, and the author said that the more generally known type of CO_2 compressor is the double-acting leather-packed machine, such as is generally used for marine purposes. This type has prevailed on account of the commercial points in its favor, and in spite of its low efficiency. The results of an interesting series of experiments on frictional losses in power to drive compressors were given.

With regard to two-stage compressors very divergent opinions exist among the leading designers of CO_2 compressors as to the advantages to be gained by compressing in two stages instead of one, but, generally speaking, there is no advantage to be gained by using two-stage compression when the range of temperature is less than 50 deg. F., or for machines of less than 20 tons refrigerating power. The paper concluded with a full consideration of wet and dry compressions, and of the minor advantages of CO_2.

CANADIAN CENSUS OF MANUFACTURES.

The official statistics of the census of Canadian manufactures for the year 1910, which have been published recently by the Department of Labor, show that the total value of the production amounted to $1,164,775,532, as against $718,352,603 for the year 1905. The figures for 1910 include the following items:—Boilers and engines, $11,873,903; bridges, iron and steel, $6,502,410; cement, $5,683,036; electrical apparatus, $15,021,840; electric light and power, $12,917,232; foundry and machine shop products, $45,611,410; gas lighting and heating, $4,005,836; iron and steel, $34,613,710; ships and ship repairs, $5,136,257; and smelting, $33,669,700.

THE READERS' POINT OF VIEW

Devoted to brief descriptive article contributions covering ideas and experiences pertaining to power plant practice and operation. We pay for accepted material.

MECHANICAL STOKER TROUBLE.

By George G. Lee.

I HAVE noticed several engineers, in plants where Jones stokers are installed, have considerable trouble starting up after the noon-hour stop, on account of the coal caking up in front of the rams, due to the heat of the deflecting plate and the brickwork. If the fuel is wet, this trouble becomes acute, and under the pressure of the rams, the body of coal becomes as solid as concrete. When this occurs, all you can do is to take off the hopper and dig out the trouble with a chisel bar or some such delicate tool.

I have found that this bother may be totally eliminated by feeding half a hopper full of ashes through the stoker, by means of the hand lever, after banking the fires.

AMMONIA REFRIGERATION.

By Charles Bishop.*

THEORETICALLY, there is really nothing to choose between the two systems of "dry" and "wet" compression of saturated ammonia vapors, and practice fully bears out the theory in this respect. The compression of saturated or super-saturated ammonia vapors is only one stage in the cycle of operations necessary in order to lower the normal heat level, and were your readers to follow up the matter, they would find that the work done by the expansion of the liquid when handled under the "dry" method practically compensates for any theoretical gain shown to be secured by the compression of the vapors under super-saturated conditions. Furthermore, it is possible with such vapors to carry over liquid in suspension, which, apart from risk of damage by mechanical effect, considerably reduces the suction volume by the subsequent expansion of this high pressure liquid down to the ruling evaporator pressure.

The question as to whether the work given out as heat during compression is best taken up by the water jacket and the oil sometimes injected, or that the refrigerator be called upon to take care of this amount of waste work, is in any case the only debatable point.

One cannot obtain something for nothing, although we all try to do so, and since we cannot make the refrigerating process a perfect reversal of the Carnot cycle, the point raised is after all a small one and a matter of practical mechanical consideration.

Referring to an article which appeared in your April issue on this subject, I note that the question of the heating of the cylinder walls is not raised by the writer, and it is just here where the so-called dry compression machine should show a loss of any magnitude.

The figures and conclusions given are not correct, as will be seen upon careful examination. I have cards taken from the best of "wet" machines that do not give a very close following to the isothermal curve, and others from the water-jacketed compressor which do not run in such close approximation to the adiabatic. I have vivid remembrance of running tests with machines working with saturated vapors, where, owing to over-load, the work could only be met by running with the delivery pipe at a temperature that would perhaps have caused your writer unnecessary worry and pain, yet the only thing much affected was, naturally enough, the coal pile.

Theory and practice show the relative merits so close as to be governed by other mechanical considerations quite apart from the difference of areas of the theoretical compression card. Whether the oil can be recovered, its vaporization prevented, to what extent the incoming gas is heated by the hot valves and cylinder walls, are, probably, points of most importance, and were the makers of the water-jacketed compressor not confident that such features can be safeguarded or compensated for by the up-to-date means used, buyers may rest assured that they would at once make the change over, which is open to them at any time. The "wet" man assures us that his vapors are just exactly saturated for the ruling conditions at the time. This is open to doubt, especially when it is considered how often changes are made to the plant, after same is designed and erected. The only evidence of this he can offer is "rule-of-thumb"—feeling the delivery pipe, and all refrigerating engineers will agree that this is absolute nonsense so far as obtaining any exact idea of the state of the vapor is concerned.

The point raised has been disposed of long ago, the opinions of the great authorities having been fully confirmed by the experience gained by many years of actual working.

*Consulting Engineer, Montreal.

A GAS ENGINE EXPERIENCE.

By Harry Westwood.

FOR the past four years I have been operating gas engines having suction and pressure producers, and my experience of them has been satisfactory. The plant I am now operating is equipped with a suction producer and a two-cylinder vertical gas engine rated at 110 horsepower. Previous to the installation of the gas plant, the factory was driven by an automatic cut-off steam engine of the same rating as the gas engine.

Our load is very irregular, as we have a double-acting air compressor, rated at 48 horsepower, working against 100 pounds pressure. This is cut out when the foregoing pressure is reached and put on again when 90 pounds shows on the gauge. It goes off and on from 200 to 300 times in one day, and when the steam plant was in operation, the voltage on the switchboard dropped from 12 to 20 volts each time the compressor started up. This made the lights so poor that we had to install another engine to drive the dynamo. With the gas engine, the voltage does not fall more than three volts when the compressor goes on, regardless of the other load.

The wrist pin brasses in this gas engine have been tightened up only once in six months, and the crank pin brasses twice in the same period. We have

splash lubrication and never know what a hot box is. We have a gauge glass attached to the bottom of the crank case, by means of which the level of the oil is in full view of the operator at all times. I will admit that it requires a man of more skill and ability to run a gas producer and engine than to run a steam plant, but the gas plant does not require as much attention while running as does the steam plant. We have not had a breakdown or even a stop exceeding twenty minutes in the last seventeen months.

The igniters are supplied with current from the dynamos at 110 volts, and they run about three months without changing. My experience with gas engines convinces me that a level head, good clean gas, and the proper amount of cylinder oil, are all that is necessary to make them the cheapest and best prime movers so far devised.

KEEPING GAS PRESSURE GAUGES BRIGHT.

By Roy Gibson.

HAVING had considerable trouble with gas pressure gauges becoming so badly discolored that they could not be easily read from a moderate distance, I hit upon the following remedy:—First remove and polish the dial, then warm same and apply paraffin wax by rubbing a candle on the warm surface. A thin coating is all that is necessary to prevent further discoloring annoyance.

I may say that our plant is equipped with two 535 h.p. double acting tandem gas engines, direct coupled to Allis-Chalmers-Bullock D.C. generators. Natural gas is used and we find it a cheap power medium. We appreciate the gas engine matter which appears each month in your magazine, The Power House.

GRAVITY LUBRICATION HINTS.

By James Ellethorn.

WHILE it is true that force feed lubricators are taking the place of the ordinary gravity types in a great many instances, there are still many thousands of the latter in use, therefore, some hints concerning them may be in order.

It is a common thing to see sight-feed glasses fouled with oil, yet by placing a piece of ordinary laundry soap at the bottom of the sight-glass, fouling will be prevented for a considerable time. Most engineers are aware of how to cause the feed oil to remain central in the glass, by placing a wire therein, but all who know about it do not take the trouble to solder or suspend the wire in place. Another remedy not generally known for this fouling annoyance is as follows:—Fill the lubricator with oil as usual, then close oil supply to and blow water from the glass. Next shut off the steam and remove the cap from glass tube and put in a little fine salt.

Often a lubricator will not work, even if the operator be a very careful man and feels certain that he has not admitted any grit or dirt into the apparatus. Sometimes, however, the thin hard scale on the inside of new pipes becomes detached and gets into the passages. Look for this trouble next time.

Occasionally, a lubricator is connected with the steam inlet above the governor valve and the outlet below it. This is a mistake, as the pressure at outlet and inlet will vary, and ,therefore, the oil supply will vary. With a light load requiring only a small feed, the oil supply will be greatest as the pressure below the valve will be lighter anl that above it heavier. Think it over and I believe you will agree with me.

There is another point to ponder over. There are hundreds of oil men and all will claim to have a cylinder oil inferior to none. Their oil may stand a fire test of over 600 degrees F., be free from grit, gum and other undesirable substances, it may have a viscosity to stand a required test, yet, after all may be almost useless for your cylinder lubrication. You will naturally ask why. I answer, because it lacks the most important requisite—it will not take hold on a wet surface and hold on. Many oils can be placed upon a dry surface and water will not wipe them off, but a cylinder oil to be of full value will take hold of the wet cylinder wall and stick to it; of course, I mean with a coating just thin enough to supply perfect lubrication. Ask your oil man to guarantee this point before you place your next order

When a bearing gets hot, do not use sand as some readers recommended in a power paper. Try Locoeq's remedy. He recommends as a rapidly cooling agent, the following:—A mixture of equal quantities of cylinder or machine oil and petroleum spirits.

SERVICE CABLES.

By Victor White.

THERE is often considerable difficulty in arranging a service cable to a consumer's premises, more especially when the latter are of the warehouse or factory description in a town which has been built for a long number of years. The original lay-out of the town in such cases is often inadequate for the expansion which has subsequently followed, and with the present day tendency for the residential portions to extend into the surrounding country, it generally happens that the central portion of such a township may become the location for factory properties of the smaller variety. In such circumstances, the streets and frontages become unduly congested, moreover the buildings themselves are not infrequently badly adapted for factory purposes; their use in this direction being chiefly promoted by the low rentals which may possibly prevail.

Street Troubles.

The initial difficulty comes in when an attempt is made to open up the thoroughfare for laying the cables, as it is generally found that the street itself is frequently congested with traffic which considerably impedes the work of excavation, and when the work is being carried underground it is usually found that there is a most disagreeable medley of sewers, telephone circuits, gas pipes, water supply pipes, etc., to be met with. As these systems were probably originally laid down many years before, their exact location may not have been properly charted.

Interior Troubles.

When the service is finally got through to the building, it will probably be found that the construction of the premises precludes a really systematic arrangement, while it is frequently found that the buildings themselves do not afford all the essentials of a fireproof nature with which the introduction of electricity should be accompanied. Under these circumstances, it is hardly to be wondered at that sometimes the service into such a building is hardly so well arranged as it would be under normal conditions of working.

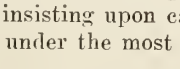
A Case in Point.

A rather interesting experience which occurred on the electricity supply system of a town which had developed industrial tendencies will show that in all cases it is advisable to make every endeavor to render the service as permanent and secure as possible. In this particular instance, there were two separate services, one being for lighting on an alternating current system, having static transformer substations in various parts of the town, the supply pressure to the consumer being at 110 volts. The second supply was for power purposes, and was a direct current system operating on 240 volts; this was fed directly from the generating station. In a small factory situated in one of the central areas of the town, there was a demand both for lighting and power, and as a result, two separate services had to be carried into the building. Owing to the constricted area in the street, and the

crowding of space in the building, the two services were carried in close together, the meter board and fuses being placed close together in the hall of the factory, which was really a large old residential buiding, converted.

All went well until, through some cause entirely unconnected with the electrical supply, the building caught fire in the night and was gutted. Before the electrical pressure could be cut off, however, the flames attacked the supply apparatus in the building, and a bad arc was started on the power service. Owing to the nearness of the lighting supply, the arc crossed over to the latter, with the result, that, for a short time, until the transformer fuses were blown at the nearest transformer substation, the current between the two systems became mixed. In other words, superposed on the 240 volt normal continuous current pressure of the power supply was an alternating pressure of 110 volts. What exactly was the maximum stress imposed upon the insulation of the power system is difficult to say, but some rather interesting developments which occurred the next day and for a little while afterwards, seemed to point to the fact that this mixing of pressure was sufficient to weaken the insulation of the cables at various points of the direct current system.

It should be explained that this direct current supply was the older of the two systems, being originally used both for power and lighting, but as the township had expanded, it had been decided to put in an alternating system for the lighting only to both the central and outlying portion of the area, reserving the existing direct current generating and distributing plant for the power supply. In this way the cables on the power system were fairly old, and may possibly have deteriorated at certain points, to a considerable extent. The first trouble noted was a short circuit to earth on one of the public arc lamp posts, the street lighting in the central portion being fed from the direct current supply. This was followed at short intervals by failures on this system, at various points of the area, and these troubles had to be removed one by one as they occurred. Finally, things settled down, and no further troubles were experienced. The matter is, however, interesting, as showing the importance to the general well-being of a supply system, of insisting upon careful service work even under the most exacting conditions.



Good machine shop foremen are not easy to obtain. It is just as well to keep a good man when one has him; it is also well to make sure he is a good man before one keeps him.

PRIZES FOR ARTICLES ON THE UTILIZATION OF WASTE.

IN a recent issue of the N. E. L. A. Bulletin, Mr. H. F. Frasse, purchasing agent, the Brooklyn Edison Co., writes as follows regarding his offer of prizes for articles on the utilization of waste:—

I am glad to note the acceptance by the Executive Committee of my offer of three prizes of $25, $15 and $5 for the best articles by members of the Association, explaining and illustrating the economies that can be effected from the utilization of "waste" material by the employes of electric light companies. I welcome the opportunity offered me to set forth briefly in the pages of the Bulletin, my ideas on the subject, as well as just a few of the lines along which higher efficiency in the use of material can be secured. The offer of three modest prizes was intended to induce a spirit of emulation and economy on the part of employes, regardless of their posts of duty. The subject is so broad that only a few suggestions are needed to show how economy and utilization may be practised—primarily for the good of the company in which the employe works and obviously for his own benefit because of assured advancement. When it is considered that more than one hundred millions of dollars were obtained in the year 1911 by the simple process of changing into bank funds that commodity flippantly known as "junk," it is evidently necessary for everyone to look to the economical operation of his own work.

The employment of cotton waste is necessary, and it can be used over and over again by a simple method of extracting the oil, either by centrifugal action or by a cheap press, the use of which oil would go towards reducing the lubrication account.

The soot from the stacks that accumulates and is shoveled into barrels and carted to the dump pile is really a high grade of lamp black , even if it is not as deep in color as that for which there is a market at six cents or more per pound. Still the soot can be used in combination with concrete to give a proper or darker tone in laying sidewalks or floors, not taking into consideration its use as a binder in briquetting coal waste.

Used machinists' files, instead of being thrown away or sold as old metal, may be restored by a simple acid bath or recut by the same sand blast which many companies employ for removing old paint from iron structures.

Many janitors, otherwise watchful, fail to recognize the profit in saving accumulations from the waste-paper baskets, old trade publications and catalogues—all of which can be baled and sold to paper mills with but a few inexpensive appliances. Naturally some system must be used to keep the catalogue covers which have been torn from the books separate from the paper, and the letter paper separate from the magazines and trade journals, keeping each class of paper to itself. One or more small forms on which to hang the burlap bags could be made from pieces of 2 by 3 spruce and stood in the corner of the cellar, and when the bags become full they might be laid aside for sale. This is preferable to allowing ragpickers or paper dealers to come into the factories and mills to cart away the material for the labor of removing it.

Old towels, wiping cloths and similar fabrics might be sold, instead of finding a last resting place in the furnace or underneath the hot water boiler.

Improvements might be made in galvanizing bolts and turnbuckles, which would permit of having the zinc coating inside the nut and on the thread so that nut and bolt would fit snugly.

The oil used in transformers might be bottled after pouring through some straining fabric, and would find ready sale to hardware, dry goods or sewing-machine stores as an inexpensive lubricant.

Scrap Metal.

Often in my negotiations with founders for the disposition of my metal accumulations, which I have no difficulty in selling direct to the users, I am told that my price is too high and that the same class of goods can be obtained from scrap dealers at a lower figure. It is fair to assume that my correspondents are telling the truth and not making the statements with the intention of getting a lower price; therefore, it is obvious that the factories, mills or shops which sell to the scrap dealers are most assuredly not receiving full value in price obtained, perhaps due to carelessness in weighing of the material. This is pertinent because it shows that the accumulations in many shops are considered as junk, that the material is in the way, and must be got rid of, whereas by the process of separating the iron, brass, copper, zinc or such metals as are to be disposed of, one may reach the ultimate buyer, the foundryman, who is willing to pay the difference above what the scrap dealer pays.

As a good deal of economy can be practised in the burning off of lead cable, weatherproof wire, etc., and in the sale direct to metal foundries, it is well to consider even the ashes in which there is more or less copper and lead and for which a good price can be had by selling to refining companies.

A great many other ideas could be set forth, but these will suffice to show how illimitable is the field of economy.

The Economical Operation of a Modern Steam Plant*

By Ivory M. Hanson**

The tendency towards increased efficiency and economy in power plant operation is exemplified in the fruitfulness of the topic at Engineering Society and Association meetings, and while much of the data dealt with may be more or less common knowledge, there remains the fact that the variety of personality discussing the subject, present it in a diversity of light, which makes it more comprehensive in its scope, effect and usefulness.

INSTANCES of marked improvement in the economy of steam plants, following the adoption of some guaranteed fuel saving appliance, often come to our notice in situations where peculiarities of structure and environment are favorable to successful operation of the device. By way of example may be cited the case of a steam plant where the draft was very poor. Shaking grates, with 25 per cent. more air space, were substituted for the stationary grates originally installed. and a lighter fire was carried. The saving was 10 per cent. The point is this: If there had been a good strong draft right along, it would have been impossible for the shaking grate to show this improvement in that particular plant; which proves that we must study local conditions if we would know just what is needed to secure good economy.

The Fuel Question.

In the matter of fuel, it is very important that we select a coal which suits the local conditions of operation as nearly as possible, for it has been shown that a certain grade of coal will often give good results in one class of steam plant and very poor results in another. The reason for this is that the conditions of draft, type of grate, furnace proportions, and design of boiler setting show considerable variation in different plants. All things considered, however, it is generally advisable to buy the best grade of coal, for there is little economy in using the cheaper grades, unless one goes to the expense of fitting up the furnaces to properly burn these grades; even then it is often questionable whether any profit will accrue in the end. In very large plants, fully equipped with special stoking machinery, it is possible to get very fair results with inferior coal; but in plants of from 500 to 2,000 horsepower, I think the best results can only be obtained by using the higher grades of coal; contingent, of course, upon a good crew of firemen.

The appearance of coal, in general, is quite deceptive; some of the best looking coals giving the poorest results, and some of the unprepossessing specimens doing exactly the contrary. It will be found advantageous, when possible, to draw up coal contracts on a B.t.u. basis. The customer then knows exactly what he is paying for. In small plants, however, this refinement will hardly pay, for the expense of testing the specimens is always considerable.

The Fire Feature.

It is good to carry a medium fire, about eight inches or thereabouts; and if the draft is induced, to fire a little heavier on the back end of the grates, for the coal usually burns faster in this region than elsewhere. There should be a definite system followed in firing. One of the best methods is to coal one-half of the furnace at a time and to allow an interval between successive firings for the smoky gases to burn. Do not allow the firemen to use the poker, slice bar, or hoe, except when absolutely necessary. Insist upon the firemen throwing the coal evenly over the whole surface of the grate, and filling up the holes as they appear. It is quite common to find firemen who merely open the firedoors, shut their eyes, and proceed to heave in the coal, regardless of where it lands; the result usually being a pile in the front part of the furnace and none in the back.

Accessory Features.

It's the little things that count for economy in the boiler house; as, for example, the fit of the tube cleaner in the boiler tubes. Firemen often object to using a tube scraper that calls for much exertion, but they should be made to use it just the same, for a loosely fitting scraper is useless for keeping clean the tube heating surface. Also, the ashes should be looked over and the larger pieces of coke picked out. It is a good thing to watch the ash pile closely. Last winter a man came to me and told me that he could make a good saving for us if we would use his compound on our ashes and burn them over again. He said that he had used it on the ashes of a local plant and had made a saving of eight per cent. He showed me a sample of the ashes and I did not doubt his statement, for the ashes were more than half good coal. I then showed him our ash pile and asked him what saving he would guarantee; but he had nothing to say.

Another simple thing, that makes for economy, is the matter of keeping the water line in the boilers at a certain height.

Boiler Operation Features.

To illustrate certain features of boiler operation, I will speak of conditions in the plant of the Talbot Mills, where I am employed. In a week's run, the average evaporation was 12.25 pounds of water, from and at 212 degrees, per pound of New River coal, which was supposed to have a heating value of 14,000 B.t.u. At times we have been able to realize in B.t.u. from the main steam pipe the same number of B.t.u that was contained in each pound of coal as burned. You will say that this is impossible, for there must be losses by radiation and otherwise. Let me explain.

Suppose we use a coal that contains about 14,000 B.t.u. per pound, and, by the combustion thereof, evaporate 12.25 pounds of water from and at 212 degrees per pound of coal. The heat in a pound of steam at 212 degrees is 1,146.6 B.t.u. Therefore, the total heat in the quantity of water evaporated per pound of coal is

$$12.25 \times 1{,}146.6 = 14{,}045$$

B.t.u., which represents a trifle more energy than was in the coal.

How do we get this? By saving the B.t.u. from the drips and from the flue gases. At times we heat our feed water to 320 degrees; but the average temperature is nearer 280 degrees. Suppose that during a certain period our feed water temperature was 300 degrees, and that we were evaporating 12.25 pounds of water per pound of coal. Then we would have

$$12.25 \times (300 - 32) = 3{,}283$$

B.t.u. that we could lose and still deliver 14,000 B.t.u., per pound of coal, from the boilers. I will be glad to discuss this proposition with any one who may doubt its accuracy.

Prime Movers.

Regarding prime movers, a great deal of praise is being lavished upon the efficiency of the steam turbine; but let us not forget that in many places the reciprocating engine is more than holding its own. The turbine, with its directly connected electric generator, seems the ideal source of motive power; but where there is use for large quantities of low

*Address delivered at the thirteenth annual banquet of the Lowell, Mass., Textile School Alumni Association.

**Chief engineer of Talbot Mills, No. Billerica, Mass.

POWER PLANT DEVELOPMENTS

A record of current municipal, manufacturing and general industrial projects, involving steam, gas, oil, electricity, air and water power equipment requirements.

BRITISH COLUMBIA.

Nelson.—Electric light extensions along the Cemetery road and in the east end of Fairview have been rushed, the former work having been completed as far as there are any residences which have been wired. The Fairview extension has also been completed. Work on the extension at the head of Stanley street has been held up by a shortage of poles.

Prince Rupert.—The new fish freezing and storage plant of the Canadian Fish & Cold Storage Co. at Prince Rupert, B.C., is to be completed about January 1, 1913. It will have storage capacity for 4,000,000 pounds of fish and freezing capacity for 100 tons daily. A fleet of nine trawlers, each having a carrying capacity of 350,000 pounds of fish, has been built in Great Britain and is being taken around Cape Horn to the Canadian Pacific fishing banks. Six other boats are being built for the company on the Pacific coast. The plant represents an expenditure of over $1,000,000. It is equipped with two 75-ton and one 50-ton refrigerating machines.

Coquitlam.—Coquitlam is to have a water works system laid down at once. Plans and specifications have been almost completed by Messrs. Wilson, Lake and Bentall for the immediate installation of a temporary water works system to supply the first division, construction on which will be started straight away. Owing to the rapidly increasing population in this locality, the old system of wells has been proved insufficient to meet the demands, and consequently the Coquitlam Terminal Company, who hold considerable property in the first division, decided to make the installation of a temporary system at their own expense, to meet the needs of the population until the municipal water works are completed.

New Westminster.—Application for extensive water rights on Brandt Creek, Indian River, Young Lake and Norton Lake is to be made shortly by the New Westminster Power Co., Ltd., as a preliminary to the establishment and erection of a power plant to supply the Fraser Valley district with current for lighting and power purposes. The New Westminster Power Co. is composed of a number of local parties, backed by English capital.

Kamloops.—Tenders are being received up to and including December 19, for 1,000 h.p. steam pumping and electrical equipment for the new power station.

ALBERTA.

Calgary.—The new contract with the Calgary Power Co. expires at the end of the year, and negotiations are now under way which will result in a saving of $4 per horse power under the new contract. Commissioner Graves has had a conference with General Manager Moore, A. E. Cross and W. H. Hogg, representing the company, and the discussions were conducted on a very amicable basis. At present the city is paying $30 per horse power, and, according to the new agreement which is being prepared, there will be a rate of $26 on a 5,000 horse power basis. If at any time during the term of the contract the city takes 10,000 horse power, a rate of $25 will be allowed. General terms of the agreement were considered, and there will be some better arrangements made. There has been considerable dissatisfaction owing to interruptions in the service, and when the agreement is completed there will likely be a large allowance made the city whenever it is found necessary to turn on the steam plant to supply the shortage. There will also be improvements in the voltage and frequency regulations.

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pressure exhaust steam, the steam engine seems to hold the advantage. I venture to state that where the power of a reciprocating engine can be transmitted directly to the centre of distribution with belts, and where the shafts are in line and running at proper speeds, and the bearings are well lubricated, the loss of power between the engine and the driven machines will not exceed 15 or 20 per cent. With the turbine, the loss in transition from steam power to electric power is at least equal to this; and besides, there are other losses due to the wiring and connections, to resistances inherent in the motors, and to the friction of the shafting, where countershafts are used; and so, all things considered, it is safe to figure on losses of from 25 to 30 per cent. after a turbine plant has been running for a considerable time.

It may be said, however, that where the belts and lines of shafting would have to be made very long for the mechanical transmission of power, and where the friction load would be very high, the turbo-electric method would undoubtedly offer superior advantages. Also, in factory or power and lighting plants where there is no use for low pressure steam, the turbine has a field of its own.

Exhaust Steam Saving.

It has been my experience that large savings can be made by the use of exhaust steam. To show you what is being done along this line, I will tell you of a manufacturing concern that has recently made some changes. This plant was equipped with motors and was supplied with electric current, for running them, at a very low price per horsepower. In the aggregate, however, the running of the plant was costing the firm an enormous sum annually. Advised by their engineer, they decided to install a 500 horsepower engine. Previously, they had been running five boilers to obtain steam for heating and for manufacturing purposes; but after putting the engine to work they found that they were getting 500 horsepower for their machinery without burning any more coal than when they were buying the power from an outside source. Finding that they could use a still larger quantity of exhaust steam, they installed a second engine, of 250 horsepower, and thereafter realized a total of 750 horsepower with a coal consumption but little in excess of what it was before they installed the engine.

To illustrate still further the usefulness of exhaust steam, I will cite another instance. In this case, an industrial firm who have been running a set of boilers on the premises to obtain steam for the heating and dyeing processes of manufacture, but who have been buying their electric power from an external source of supply, have decided to install a low pressure turbine, instead of a reciprocating engine, because they are already equipped with motors for driving their machinery and are apprehensive regarding the oil in the exhaust from an engine cylinder. While, for many reasons, they would prefer to put in a reciprocating engine, still the guaranty of clean exhaust steam for the dye kettles inclines them toward the turbine as the safer venture.

Cylinder Oil Trouble.

At the Talbot Mills we have had little or no trouble on account of cylinder oil in the dye tubs. We use a good separator and discharge all drips from low points in the steam pipe into the river. You may be sure that if the main pipe is well drained, and the supply pipes are from the upper side of the main pipe, there will be no trouble on account of oil. The low pressure system which we use is original with us. A number of manufacturing plants are using the same system; having copied the ideas embodied in our plant. As a matter of fact, I know of one firm, who make a business of installing the low pressure system, and who got their ideas, indirectly, from the Talbot Mills plant.

In closing, I wish to say that the most important adjunct of the steam plant is a good engineer. It pays to employ a good man and to remunerate him commensurately with his worth; for the high class engineer can more than save his salary by closing up avenues of loss that might otherwise exist, if a man of poor or mediocre ability were on the job.

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AGAINST BOILER ROOM ACCIDENTS. Even a light coating of scale on the tube prevents the water from coming in contact with the metal, and the intense heat to which boiler tubes are subjected burns out the metal and an explosion is liable to happen, which frequently results in the loss of life.

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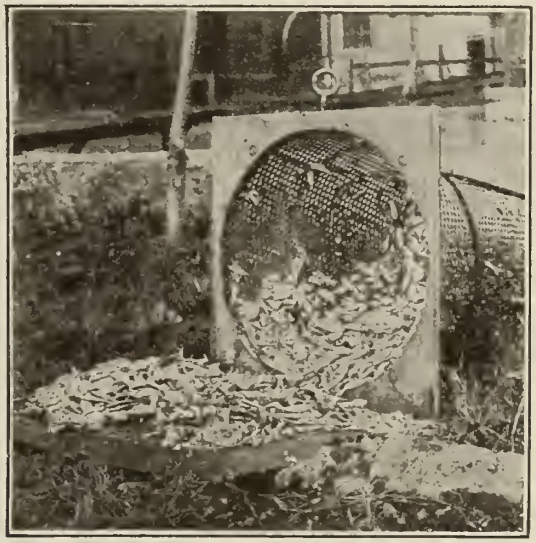

A six-hour catch of fish, leaves, etc., made by one basket of a Twin Strainer.

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to protect every plant that draws its water supply from lakes, ponds or rivers.

and the only convenient and efficient way to remove it from your water supply is with a Twin Strainer.

The TWIN STRAINER has two straining baskets and is made so that either one of the baskets may be cut out of the line at any time for cleaning, by simply shifting two valves.

If you are not acquainted with the Twin Strainer write for our catalog. It's ready for you.

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Williams & Wilson, Ltd., Montreal. A. R. Williams Machinery Co., Ltd., Toronto and Winnipeg.

The advertiser would like to know where you saw his advertisement—tell him.

Edmonton.—The King Edward Hotel has been equipped with a 5-ton refrigerating plant furnished by the Armstrong Machinery Co., Spokane, Wash. The plant is operated on the brine system.

Calgary.—The Alberta Ice Co. has purchased a Gifford-Wood Co. ice elevator with twelve gallery hoists and rope drive. The machinery is now being installed and will be put into operation as soon as ice is thick enough to harvest.

Calgary.—Improvements to cost approximately $1,000,000 have been commenced by the Calgary Power Co. at Kananaskis Falls, fifty miles west of the city. The plant is expected to be in operation by November, 1913, the new unit having a capacity of 10,000 horse power.

Calgary.—The municipal council have been asked to approve the purchase of a motor-driven pump of 10,000,000 gallons capacity. This is to be placed one mile west of the present pumping plant and will cost $20,000.

SASKATCHEWAN.

Regina.—That Regina's power plant is a big asset to the city is revealed by the report presented by E. W. Bull, superintendent at the power house, at the annual meeting of ratepayers. It only required less than 75 per cent. of the receipts for power to meet all charges against the plant during the past year, including operation, and in addition the city secured its street lighting without additional cost. The power plant has grown to be a big utility. The receipts for power used during the present year up to the end of October is given as $152,078.21. Of that amount $47,790 is clear profit. It was also decided during the early part of the year that a portion of the surplus be devoted to further extensions of the system. Altogether $11,656.85 was expended on poles and wires; $254 for street lighting (capital), and $7,003.33 for the operation of the street lights. If all these amounts are taken into consideration it will be seen that the actual surplus is in the neighborhood of $70,000.

Regina.—Mr. Wynne-Roberts has reported that the two thousand million tons of lignite in the southern portion of this province is suitable for power production.

Yorkton.—The contracts for the equipment of the electrical plant for this town have been awarded as follows: Canadian Boving Co., Diesel engine; Westinghouse Co., switchboard; Siemens Co., alternator and exciter. The cost of the work is given at $39,453.30.

Regina.—Tenders are being received up to and including December 14 for the construction of a power house, laundry and refrigerating plant for Regina General Hospital.

Moose Jaw.—The demand for electric energy from the city power plant can be taken as a very excellent barometer of trade and commercial conditions and industrial progress in the city, and the fact that the demand is nearly double this year, with only eight months of active operation, what it was for the twelve months of last year, is a good indication of the growth and prosperity of the city. Superintendent Peters is now making up his annual report of the work of the Electrical Department for the past year, or accurately speaking, for the eight months during which the plant has been in operation. The demand for current for both light and power during the year has been much greater than in any proceeding year. The increase in 1912 has been large, but the estimated increase for 1913 is even greater, although at the present time it is difficult to even form an approximate estimate of what it will be. The increase of power consumption in 1911 over that used in 1910 was 7 per cent., while the increase of 1911 over 1909 was 169 per cent. A comparative statement of the number of kilowatt hours generated since 1909 and the approximate amount generated during the eight months of this year and the estimate for next year is as follows:

1909	462,790 K.W. H.
1910	703,910 K.W. H.
1911	1,246,977 K.W. H.
1912, approximately	2,000,000
1913, estimated	5,000,000

The new power house which is now under construction, and will take the place of the old power house and pumping station, destroyed by fire on the morning of May 25th, will house the most modern municipal power plant in Western Canada when it is completed. Everything in it will be modern. The pumping station has been completely separated from the power plant and is a building by itself.

MANITOBA.

Dauphin.—At the usual fortnightly meeting of the city council, in addition to the usual routine business, a report was brought up by the fire, light and power committee. It was explained that owing to the rapid growth of the city the power plant was being worked to its capacity. It was the unanimous opinion of the council that a new plant should be built with three times the capacity of the present outfit, and so arranged that a heating plant be connected for the purpose of supplying heat to the business and residential blocks from the exhaust steam.

ONTARIO.

Dryden.—Fire destroyed the power house and sluice gates of the Dryden Timber and Pulp Co. on November 28, entailing a loss of $100,000. The loss falls on Harris & Harris, contractors, who control the complete works.

West Lorne.—Excavation work was started on November 27 on the new electric light plant here, and the system, it is expected, will be in operation early in the new year. The new building will be of brick, one story, 45 by 25 feet.

Owen Sound.—The Georgian Bay Power Co., which a few years ago started to develop Eugenia Falls as a power proposition, has disposed of its property and small power house to the Hydro-Electric Commission. Thos. McLaughlin, secretary of the company, was in Flesherton recently, and confirmed the report of the sale. It is said that the Commission is going to develop the Eugenia water falls for the towns in this part of the province. Eugenia Falls are on the Beaver River, situated about 35 miles from Owen Sound. The Hydro-Electric Commission will place propositions before Owen Sound and Meaford at an early date, and it is understood that they intend to supply current from this point. Engineers report that about 3,000 h.p. can be developed.

London.—Chairman Pocock, of the Water Commission, recently announced that the electrical department would have 4,800 customers for hydro-electric by the end of November, the completion of their financial year. The peak load bought from the Ontario Commission at the present time is 3,200 horse-power, but the department is disposing of about 4,800 horse-power here, the overlapping making up the difference. The peak is 200 horse-power in excess of the amount contracted for, namely, 3,000. The first estimate was 5,000 horse-power, but it was later reduced to 3,000. Mr. Pocock estimates that the consumption will increase greatly during the coming year. The receipts for the year will be in excess of the estimates. It is believed that the surplus will run over $20,000 for the year. It will be retained in the department, however, and will be applied to the purchase of new equipment.

Toronto, Ont.—Mr. R. C. Harris, Commissioner of Works, has presented an estimate of costs regarding the installation of mechanical filters to safeguard water users in sections of this city recently annexed. In his report he states that the cost would be about $56,000 for a pumpage of 2,500,000 gallons per day.

St. Thomas.—It is reported that the Hydro-Electric department of this city has 4,800 consumers.

Brantford.—The municipal water commissioners are considering the extension of the waterworks as required by the fire underwriters. The cost of this work is estimated at $150,000, and this includes a considerable quantity of iron pipe.

Ottawa.—The plans for the Ottawa filtration plant have been unanimously approved by the Provincial Board of Health.

Fort William.—Mr. M. O. Robinson, manager of the joint board of street railway commissioners, has stated that the power house in this city is working at maximum output, and if additional cars are required a substation and generator will have to be added to the service.

Tilsonburg.—The Tilsonburg Pork Packing Co. lost its packing house by fire early in November, with loss of about $30,000. The plant is to be rebuilt. John Londan was the principal owner.

Hamilton.—The Hydro-Electric Board recently decided that the city needed more electric power. Manager Barber announced that they were using much more than the 2,000 horsepower contracted for, and he was instructed to order 1,000 horsepower more. Mayor Lees said that early next year he believed the city would require 5,000 or 6,000 horsepower.

St. Catharines. — The directors of the Niagara, St. Catharines and Toronto Railway will erect a large power house in this city. Mr. Seixas is general manager.

QUEBEC.

Montreal.—The Town of St. Laurent is seeking a number of charter amendments from the Legislature. The principal demand is that the town be authorized to sell its waterworks system to private individuals or corporations. It is provided that tenders must be advertised for, and that the future owners of the waterworks shall not be allowed to charge more for supplying water to the citizens than the present municipal rate.

Montreal.—The Ice Manufacturing Co., Ltd., recently organized with W. T. Rodden president, and incorporated with $1,250,000 capital, will construct three ice storage houses, one in the central part of the city, one in the north end, and one in the west side. The company will build a distilled water ice-making plant of 200 tons daily capacity, with provision for enlargement.

Montreal.—The Village of Sault au Recollet has a bill to amend its charter coming before the Legislature this session. The chief item is one to ratify the arrangement made with Mr. Gustave des Trois-Maisons, whereby the town will take over the waterworks, previously the property of that gentleman.

NEW PUBLICATION.

The counter-current or multi-stage principle in steam generation, towards the adoption of which there appears to be a tendency in recent practice, is discussed in a pamphlet entitled "The Best Proportions of Boiler and Economizer Surface," issued by the Green Fuel Economizer Co., of Matteawan N.Y. In this booklet a method is developed for determining the proper limits of boiler and economizer surface, and it is shown that the most economical results are obtained from a boiler properly proportioned, for transmitting the heat of evaporation, with an economizer for progressively warming the feed water. The practical result is a boiler of 4 to 6 square feet per boiler horse-power, discharging gases at 600 to 700 deg. F. to an economizer in which they are cooled to 300 deg. F. or lower, depending upon whether or not mechanical draft is used. It is pointed out that the economizer transfers two or three times as much heat as could the same amount of additional boiler surface at the same point in the travel of the gases because of the greater temperature head available between the hot gases and feed water as compared with that between gases and steam, the result being greater steam making efficiency at lower cost.

"Direct and Alternating Current Manual," by Frederick Bedell. Published by the D. Van Nostrand Co., New York. Price $2.00 net. The first edition of this work was issued in 1909, under the title of "Direct and Alternating Current Testing" and, as promised by the author in that edition, important additional matter has been added regarding alternating current motors and convertors. It is only a few years since, when difficulty would have been encountered in finding in the general technical works anything approaching a full treatment of the principles of A.C. machinery. Indeed, it was felt that the manifold objections to the extensive commercial application, not then removed left doubtful, at all events, its immediate usefulness, unless for long distance transmission. It is, therefore, suggestive as an indication of what has been so soon accomplished that fully two-thirds of this work deals with A.C. apparatus. The matter throughout is systematically arranged in sections and the particular tests, described as typical in each case, have been happily chosen to assist the student in the cultivation of accurate and truthful observation. The introductory study to each section, although necessarily curtailed, is yet unusually clear, thus giving the work the distinct additional educational value which follows the systematic practice of reason. The general text is amplified where considered expedient by notes and appendices in small type, and quite a number of useful hints are given of really practical value. Although, as already mentioned, the work is primarily for use in the laboratory, yet as no unusual facilities are demanded for carrying out the tests, it will be found of general assistance where the ordinary measuring apparatus is available.

CATALOGUES.

Mr. John Hammersley, inspecting engineer and machinery exporter, of Regent Chambers, 100, Deansgate, Manchester, sends us a copy of a handy catalogue of small selected prime movers, which he supplies. Crude oil engines of the semi-Diesel type take the premier position therein, and there are some useful accompanying notes on the utility of this type of engine. A neat two-stroke valveless engine for gas or petrol, and a robust type of horizontal oil engine, follow. Suction gas plants and wind motors are also included. Mr. Hammersley, by the way, makes a specialty of the inspection and testing of machinery and plant in England for buyers abroad. He also undertakes the preparation of specifications and plans of any class of machinery.

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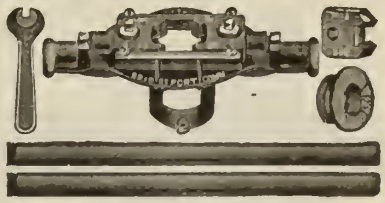

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W. C. McGHIE,
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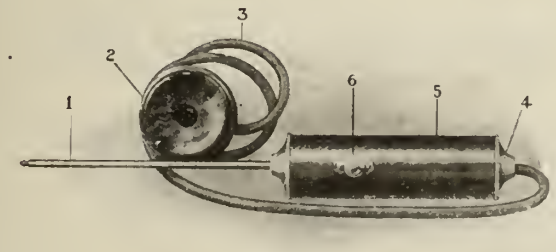

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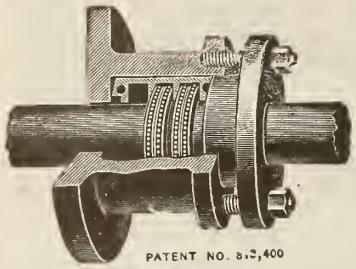

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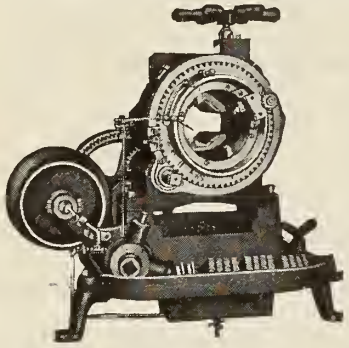

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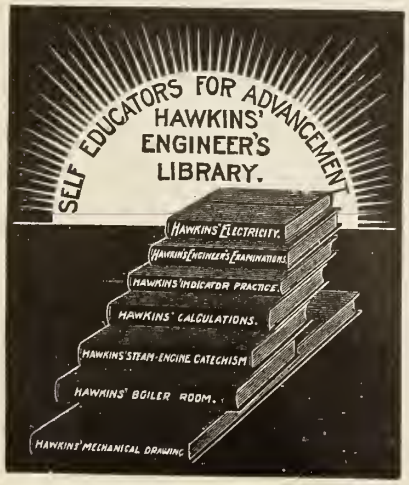

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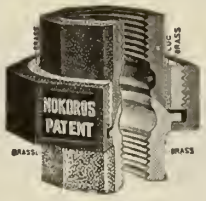

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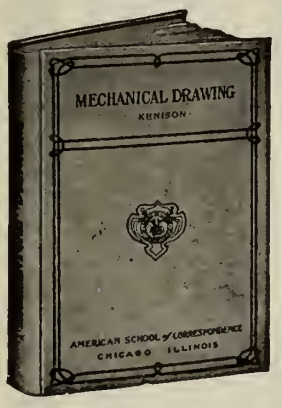

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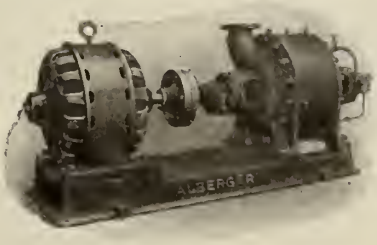

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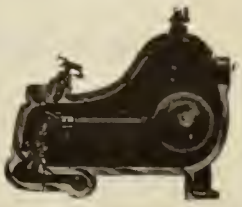

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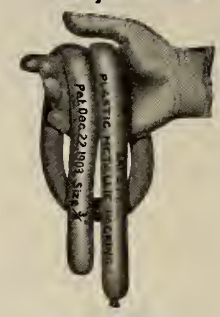

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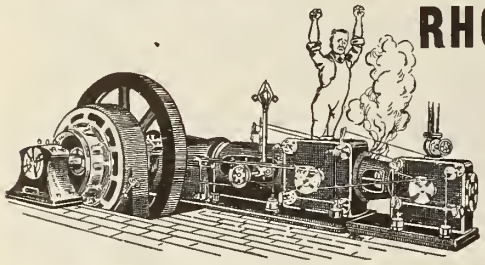

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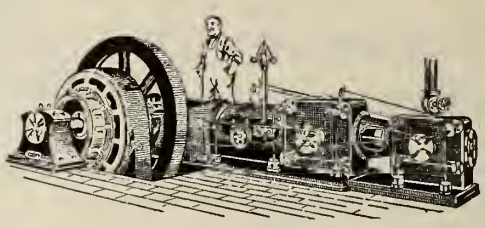

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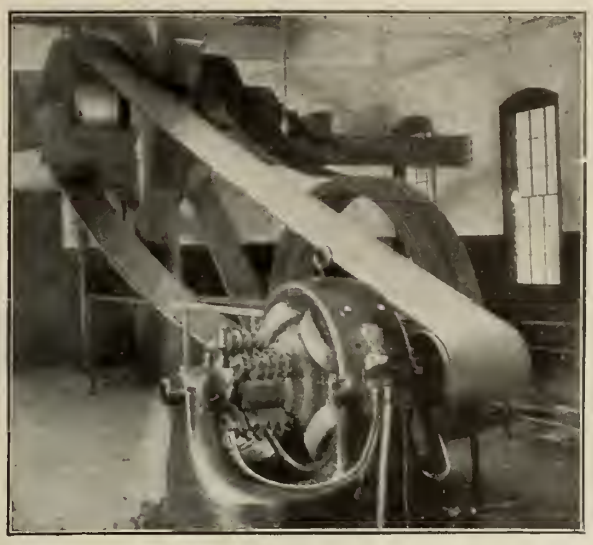

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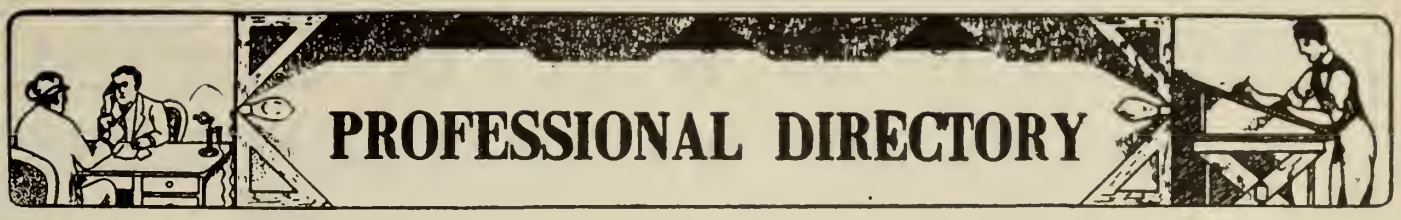

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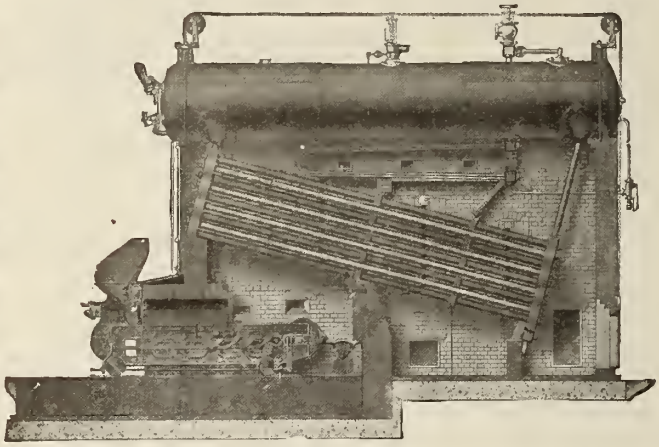

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Robb Engineering Co., Amherst, N.S.
Railway Equipment Co., Toronto.

Excavators.
C. O. Bartlett & Snow Co., Montreal

Engineers' Supplies.
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Exhaust Fans.
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General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.

Exhaust Heads.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Jas. Morrison Brass Mfg. Co., Toronto.
The Sims Co., Erie, Pa.
Steam Appliance Co., Milwaukee, Wis.
Watson & McDaniel Co., Philadelphis

Expansion Joints.
Alberger Condenser Co., New York.
Lunkenheimer Co., Cincinnati, O.

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H. L. Peiler & Co., Montreal.

Feed Water Analyser.
Dearborn Drug and Chemical Works, Chicago.
C. C. Snowdon, Calgary.

Feed Water Heaters.
Alberger Condenser Co., New York.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
National Pipe Bending Co., New Haven, Conn.
H. L. Peiler & Co., Montreal.
Robb Engineering Co., Amherst, N.S.
The Sims Co., Erie, Pa.
Waterous Engine Works Co., Brantford.

Feed Water Regulators.
Canada Foundry Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.

Filters.
John McDougall Caledonian Iron Wks, Montreal.

Fire Hose.
Dunlop Tire and Rubber Goods Co., Toronto.
Quaker City Rubber Co., Philadelphia, Pa.

Fire Brick.
Alex. Gibb, Montreal.

Fireproof Cold Store Doors and Windows.
Jones Cold Store Door Co., Hagerstown, Md.

Flanges.
Dart Union Co., Toronto.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.

Flue Brushes.
General Supply Co. of Canada, Ottawa
Steam Appliance Co., Milwaukee, Wis.

Flumes, Steel.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
E. Leonard & Sons, London, Ont.

Freezer Doors.
Jones Cold Store Door Co., Hagerstown, Md.

Insulators.
Ed. Bennis & Co., Ltd.
Geo. H. Tod, Toronto.

Furnace Linings.
Hare Eng. Co., Toronto.

Fuses.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Canadian General Electric Co., Ltd., Toronto.

Gaskets, Rubber, Asbestos and Copper.
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Goetze-Gasket & Packing Co., New Brunswick.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Dunlop Tire and Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Canada, Ottawa

Gas Exhausters.
Hare Eng. Co., Toronto.

Gas Producer Plants.
Canadian Boving Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Fraser & Chalmers, Ltd., Montreal.
E. Leonard & Sons, London, Ont.

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Can. Fairbanks-Morse Co., Montreal.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
H. L. Peiler & Co., Montreal.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

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Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.
H. L. Peiler & Co., Montreal.

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J. C. Wilson & Co., Glenora, Ont.

Gears, Spur Level.
Manitoba Bridge & Iron Works Limited, Winnipeg.
J. C. Wilson & Co., Glenora, Ont.

Generators.
W. H. Allen Son & Co. Bedford, Eng.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal.

Governors, Water Wheel
W. H. Allen Son & Co. Bedford, Eng.
J. C. Wilson & Co., Glenora, Ont.

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Jos. Dixon Crucible Co., Jersey City.
General Supply Co. of Canada, Ottawa
C. C. Snowdon, Calgary.

Graphitol.
British Pacific Supply Co., Victoria, B.C.

Grates.
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Ltd.
Boiler Repair & Grate Bar Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.
Geo. H. Tod, Toronto.

Grease Cups.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
Detroit Lubricator Co., Detroit.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
F. J. Schuch, Toronto.

Grease and Oil Extractors.
Canada Foundry Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
C. C. Snowdon, Calgary.
Hare Eng. Co., Toronto.
Steam Appliance Co., Milwaukee, Wis.

Greases.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria, B. C.
Can. Fairbanks-Morse Co., Montreal.
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

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C. O. Bartlett & Snow Co., Montreal
Can. Fairbanks-Morse Co., Montreal.
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Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

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General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Hare Eng. Co., Toronto.
E. Leonard & Sons, London, Ont.
H. L. Peiler & Co., Montreal.
The Sims Co., Erie, Pa.

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Garlock Packing Co., Hamilton, Ont.

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Canada Foundry Co., Ltd., Toronto.

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The Deming Co., Salem, O.
John McDougall Caledonian Iron Wks, Montreal.

Hydraulic Presses.
Bawdon Machine Co., Toronto.

Hydro Extractors.
Jones & Glassco, Montreal,

Ice Making Machinery.
Linde British Refrigeration Co., Montreal.

Indicators, Electric—All Types.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Indicators, Steam and Gas Engine.
Can. Fairbanks-Morse Co., Montreal.
H. L. Peiler & Co., Montreal.
The Maihak Indicator Agy., Montreal.

Indicators—Ammonia, Hydraulic.
Detroit Lubricator Co., Detroit.

Indicating.
Renown Engine & Machine Co., Montreal.

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Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.

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Insulating Tapes & Varnishes.
Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

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Monarch Electric Co., St. Lambert, Que.

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Imperial Waste & Metal Co., Montreal.

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Lamps, Arc, Incandescent.
Canadian General Electric Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canadian Westinghouse Co., Hamilton
P. H. Klein, Jr., Co., Montreal.
Northern Electric & Mfg. Co., Limited, Montreal.
A. H. Winter Joyner, Toronto.

Lubricants.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
Britisb Pacific Supply Co., Victoria,
Can. Oil Companies, Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

Lubricators, Force Feed.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
Darling Bros., Montreal.
Can. Detroit Lubricator Co., Windsor,
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N.Y.

Lubricators, Plain.
Can. Detroit Lubricator Co., Windsor, Ont.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.

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Dunlop Tire & Rubber Goods Co., Toronto.
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Ed. Bennis & Co., Ltd.
Fraser & Chalmers, Ltd., Montreal.
Hare Eng. Co., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.

Metal Cutting (Oxy-Hydrogen).
Franco-Can. Welding Co., Toronto.

Metal Welding.
Franco-Can. Welding Co., Toronto.

Meters, Electric.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Monarch Electric Co., St. Lambert, Que.

Meters, Water.
H. L. Peiler & Co., Montreal.

Mica.
Kent Brothers, Kingston, Ont.

Mill and Mining Machinery.
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Can. Fairbanks-Morse Co., Montreal.
Fraser & Chalmers, Ltd., Montreal.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.
Jenckes Machine Co. Sherbrooke, Que
Robb Engineering Co., Amherst, N.S.
Railway Equipment Co., Toronto.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Molds, Rubber.
Bawdon Machine Co., Toronto.

Motors.
W. H. Allen Son & Co. Bedford, Eng.
Can. Fairbanks-Morse Co., Montreal.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton
Northern Electric & Mfg. Co., Limited, Montreal.
Railway Equipment Co., Toronto.

Motor Starters and Controllers.
W. H. Allen Son & Co. Bedford, Eng.
Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co., Hamilton

Office Railings.
Jas. Morrison Brass Mfg. Co., Toronto.

Oil Cups.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Oiler Compound Feeders.
Lunkenheimer Co., Cincinnati, O.

Oilers, Gauge.
Lunkenheimer Co., Cincinnati, O.

Oilers, Multiple.
Can. Detroit Lubricator Co., Windsor,
Lunkenheimer Co., Cincinnati, O.

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Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Jas. Morrison Brass Mfg. Co., Toronto.
The Sims Co., Erie, Pa.

Oil Separators, Ammonia.
Steam Appliance Co., Milwaukee,

Oil Separators.
Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Liberty Mfg. Co., Pittsburg.
Jas. Morrison Brass Mfg. Co., Toronto.
Steam Appliance Co., Milwaukee,

Oils, Lubricating.
Adams Cooks Son, New York.
Albany Lubricating Co., New York.
British Pacific Supply Co., Victoria.
Can. Oil Companies, Ltd., Toronto.
Dearborn Drug and Chemical Works Chicago.
C. C. Snowdon, Calgary.

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Franco-Can. Welding Co., Toronto

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Can. H. W. Johns-Manville Co., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Canada, Ottawa
Steel Mill Packing Co., Windsor, Ont.

Packing, Metallic.
General Supply Co. of Canada, Ottawa
Holmes Metallic Packing Co., Wilkesbarre, Pa.
H. L. Peiler & Co., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.
Rhodes Improved Metallic Packing Co., Ltd., Montreal.
Steel Mill Packing Co., Windsor, Ont.

Packing, Rod.
Goetze-Gasket & Packing Co., New Brunswick, N.J.
Canadian H. W. Johns-Manville Co. Ltd., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
General Supply Co. of Canada, Ottawa
Steel Mill Packing Co., Windsor, Ont

Packing, Sheet.
Dunlop Tire & Rubber Gods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
General Supply Co. of Canada, Ottawa
Quaker City Rubber Co., Philadelphia, Pa.
F. J. Schuch, Toronto.

Packing, Ammonia, Steam and Water.
Canadian H. W. Johns-Mansville Co., Toronto.
Dunlop Tire and Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.
General Supply Co. of Canada, Ottawa
Quaker City Rubber Co., Philadelphia, Pa.
F. J. Schuch, Toronto.
Steel Mill Packing Co., Windsor, Ont.

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Dunlop Tire and Rubber Goods Co., Toronto.

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Packing Rubber.
Dunlop Tire and Rubber Goods Co., Toronto.

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Are you spending a good part of your Sundays at work in a Boiler?

It's a fierce job trying to keep a boiler clean at any time, but especially in a plant where the only chance to cut out a boiler is during the week-end.

YOU can reduce the labor and expense of boiler cleaning and cut down your consumption of fuel by using

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or FEED WATER TREATMENT

Let us co-operate with you in an attempt to end your boiler troubles by eliminating or counteracting your scale formation.

Send us a sample of feed water or of boiler scale with particulars of operating conditions and we will treat your case thoroughly and individually.

WE WILL GUARANTEE GOOD RESULTS

Our Boiler Compounds are like our Oils—BEST by TEST

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Curtis & Curtis Co., Bridgeport, Conn

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Canadian Boving Co., Toronto.
E. Leonard & Sons, London, Ont.

Pipe (Second-Hand).
Imperial Waste & Metal Co., Montreal.

Pipes, Water.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Pacific Coast Pipe Co., Vancouver, B. C.

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Jas. Morrison Brass Mfg. Co., Toronto.

Piping, Steam.
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Deming Co., Salem, O.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Goulds Pump Co., Montreal.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Garlock Packing Co., Hamilton, Can.

Power Transmission Machinery.
Can. Fairbanks-Morse Co., Montreal.
Elmira Machinery & Transmission Co., Elmira, Ont.
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Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Columbus.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Pulleys.
C. O. Bartlett & Snow Co., Montreal
Can. Fairbanks-Morse Co., Montreal.
Crescent Oil Co., Hamilton, Ont.
Elmira Machinery and Transmission Co., Elmira, Ont.
General Supply Co. of Canada, Ottawa
Jeffrey Manufacturing Co., Columbus.
Manitoba Bridge & Iron Works Limited, Winnipeg.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Pulp Mill Machinery.
W. H. Allen Son & Co. Bedford, Eng.
Escher, Wyss & Co., Toronto.
Jeffrey Manufacturing Co., Columbus.
E. Leonard & Sons, London, Ont.
Waterous Engine Works Co., Brantford.

Pumping Machinery.
W. H. Allen Son & Co. Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Canada Fdry Co., Ltd., Toronto.
Deming Co., Salem, O.
General Supply Co. of Canada, Ottawa
Standard Eng. Co., Toronto.
Waterous Engine Works Co., Brantford.

Pumping Machinery, Electrical.
W. H. Allen Son & Co. Bedford, Eng.
Chicago Pump Co., Chicago, Ill.
Jeffrey Manufacturing Co., Columbus.

Pump Governors and Regulators.
Canadian Steam Boiler Equipment Co., Toronto.
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C. A. Dunham Co., Toronto.
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Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.
Watson & McDaniel Co., Philadelphia.

Pump Strainers.
Canadian Steam Boiler Equipment Co., Toronto.
Liberty Mfg. Co., Pittsburgh, Pa.

Pumps, Air.
W. H. Allen Son & Co. Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Canada Foundry Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Deming Co., Salem, O.
General Supply Co. of Canada, Ottawa
E. Leonard & Sons, London. Ont.

Pumps, Centrifugal.
W. H. Allen Son & Co. Bedford, Eng.
Alberger Condenser Co., New York
A. W. Bennet, Toronto.
Canada Foundry Co., Ltd., Toronto.
Canadian Boving Co., Toronto.
Deming Co., Salem, O.
Canadian Boving Co., Toronto.
Escher, Wyss & Co., Toronto.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
E. Leonard & Sons, London, Ont.
John McDougall Caledonian Iron Wks. Montreal.
Waterous Engine Works Co., Brantford.

Pumps, Geared, Compound.
American Steam Pump Co., Battle Creek, Mich.
Canada Foundry Co., Ltd., Toronto.
Deming Co., Salem, O.
Can. Fairbanks-Morse Co., Montreal.
E. Leonard & Sons, London, Ont.

Pumps, Hydraulic Pressure.
American Steam Pump Co., Battle Creek, Mich.
Canada Foundry Co., Ltd., Toronto.
The Deming Co., Salem, O.

Pumps, Oil.
The Deming Co., Salem, O.
Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, O.
Manzei Cros. Co., Buffalo, N.Y.
Michigan Lubricator Co., Detroit.

Pumps, Steam.
W. H. Allen Son & Co. Bedford, Eng.
American Steam Pump Co., Battle Creek, Mich.
Bawdon Machine Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
The Deming Co., Salem, O.
C. A. Dunham Co., Toronto.
General Machinery Co., Toronto.
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.

Pumps, Vacuum.
W. H. Allen Son & Co. Bedford, Eng.
Alberger Condenser Co., New York.
American Steam Pump Co., Battle Creek, Mich.
Canadian Boving Co., Toronto.
Canadian Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
C. A. Dunham Co., Toronto.

Pnmp Tank, Receiver.
American Steam Pump Co., Battle Creek, Mich.
Canada Fdry. Co., Ltd., Toronto.

Pyrometers.
Jas. Morrison Brass Mfg. Co., Toronto.

Rails (Relaying).
Imperial Waste & Metal Co., Montreal

Radiator Air Vents.
Jas. Morrison Brass Mfg. Co., Toronto.

Refrigerator Doors, Windows, Etc.
Jones Cold Store Door Co., Hagerstown, Ind.

Refrigerating Engineers.
Chas. Bishop, Montreal.

Refrigeration Machinery.
International Marine Signal Co., Ottawa.
Linde British Refrigeration Co., Montreal.
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Regulators, Pressure.
C. A. Dunham Co., Toronto.
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Revolving Doors for Hardening Rooms.
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Canadian General Electric Co., Ltd., Toronto.
Canadian Westinghouse Co.. Hamilton

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Garlock Packing Co., Hamilton, Ont.
General Supply Co. of Can., Ottawa.
Liberty Mfg. Co., Pittsburg. Pa.
Quaker City Rubber Co., Philadelphia,

Rubber Specialties.
Dunlop Tire & Rubber Goods Co., Toronto.

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Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

Safety Valves.
Can. Fairbanks-Morse Co., Montreal.
General Supply Co. of Canada, Ottawa
Lunkenheimer Co., Cincinnati, O.
H. L. Peiler & Co., Montreal.

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C. O. Bartlett & Snow Co., Montreal

Shafting.
C. O. Bartlett & Snow Co., Montreal
Elmira Machinery and Transmission Co., Elmira.
General Supply Co. of Canada, Ottawa
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
Waterous Engine Wks. Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

Shaking and Dumping Grates.
Babcock & Wilcox, Montreal.
Can. Steam Boiler Equipment Co., Toronto.
Hare Eng. Co., Toronto.
Waterous Engine Wks. Co., Brantford

Smoke Consumers.
Automatic Smoke Prevention Co., Montreal.
Canadian Steam Boiler Equipment Co., Toronto.

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Babcock & Wilcox, Montreal.
Canada Fdry. Co., Ltd., Toronto.
E. Leonard & Sons, London, Ont.
Waterous Engine Wks. Co., Brantford

Smokeless Furnaces.
Jones Underfeed Stoker Co., Toronto.
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Geo. H. Tod, Manning Chambers, Toronto.

Soot Cleaners.
Vulcan Tube Cleaning Systems, Ltd., Montreal.

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Can. Fairbanks-Morse Co., Montreal.
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J. C. Wilson & Co., Glenora, Ont.

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C. O. Bartlett & Snow Co., Montreal
Manitoba Bridge & Iron Works, Ltd., Winnipeg.
Waterous Engine Wks. Co., Brantford

Spur Wheels.
Can. Fairbanks-Morse Co., Montreal.
Waterous Engine Wks. Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

Stand Pipes, Steel.
Canada Fdry. Co., Ltd., Toronto.

Steam Separators.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
H. L. Peiler & Co., Montreal.
The Sims Co., Erie, Pa.
Steam Appliance Co., Milwaukee.
Watson & McDaniel Co. Philadelphia

Steam Specialties.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
General Supply Co. of Canada, Ottawa
Hare Eng. Co., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co. Toronto.
H. L. Peiler & Co., Montreal.
Penberthy Injector Co., Windsor.
The Sims Co., Erie, Pa.
Steam Appliance Co., Milwaukee.
Watson & McDaniel Co. Philadelphia
Vulcan Tube Cleaning System, Ltd., Montreal.

Steam Traps.
V. D. Anderson Co., Cleveland, O.
Can. Fairbanks-Morse Co., Montreal.
Canada Foundry Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
C. A. Dunham Co., Toronto.
General Supply Co. of Canada, Ottawa
Elliott Co., Pittsburgh, Pa.
Hare Eng. Co., Toronto.
Can. Morehead Mfg. Co., Woodstock,
H. L. Peiler & Co., Montreal.
Schneider & Helmecke, Madgeburg, Germany.
Steam Appliance Co., Milwaukee. W. Watson & McDaniel Co., Philadelphia

Steam Turbine Blowers.
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Robb Eng. Co., Amherst. N.S.

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Babcock & Wilcox, Montreal.

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Jenckes Machine Co., Sherbrooke, Que.
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Canadian Westinghouse Co., Hamilton
Escher, Wyss & Co., Toronto.
Hare Eng. Co., Toronto.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Wks. Montreal.
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Canadian Steam Boiler Equipment Co., Toronto.
Darling Bros., Montreal.
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H. L. Peiler & Co., Montreal.
Morehead Mfg. Co., Detroit, Mich.

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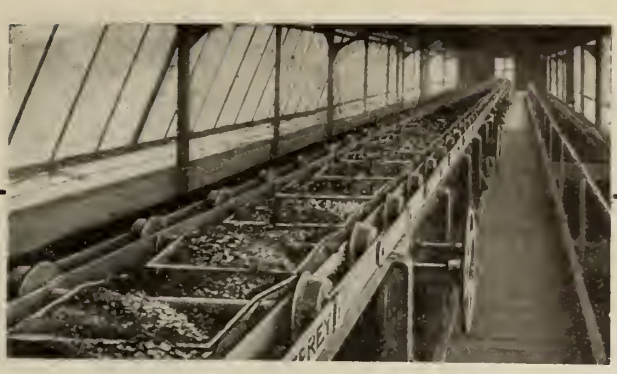
Goetze-Gasket & Packing Co., New Brunswick, N.J.

Valve, Reseating Machines.
Darling Bros., Montreal.

Valves.
Canada Fdry Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.



Upper Run over Bunkers

Increase the service of your Power Plant—handle your coal and ashes in minimum time at a minimum expense.

Jeffrey Pivoted Bucket Equipments

for handling Coal and Ashes are practical, economical, labor saving.

The Initial Cost is low—Operating and Maintenance Costs are reduced to the lowest minimum.

Write for Catalog 32-A, showing how we have solved coal and ashes handling problems in over fifty different power plants.

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Canadian Works and Main Office, MONTREAL
Winnipeg Representatives N. J. DINNEN & CO.

MADE IN

CANADA

The Lowest in Cost and Best

High Pressure Gaskets

On the Market

Because 1. They are permanent. 2. They are easy to apply. 3. They are easy to remove. 4. It is impossible to blow them out. 5. They will not stick to the metal. 6. They can be used over again. 7. They are not affected by high temperature. 8. Cleaning the joints after using these gaskets is unnecessary. 9. There is no danger of of damaging the gaskets in breaking or making the joint over. 10. There is no time lost in preparing these gaskets for the joint. They are always ready.

Write us at once for circulars and prices, and avoid duty.

CANADIAN GASKET COMPANY

BRIDGEBURG, ONT.

TIME AND LABOR SAVING MACHINERY

WITH LOW COST OF MAINTENANCE

Equipments for the Low Cost of Handling Materials

—

Conveying and Elevating Machinery

—

Power House Coal and Ash Handling Systems

—

Direct and Steam Heating Dryers

—

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—

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You can greatly increase your profits by using machinery to do your work instead of employing a number of men. The first cost of our machinery is practically the only cost—after that is covered there is nothing but profit.

Do not continue the old way—change your methods at once and you will be surprised with the results obtained after installing the modern way of handling materials.

Our Engineering Staff is at your service—they will develop machinery to meet your conditions.

Write for particulars.

The C.O. Bartlett & Snow Co. of Canada
Limited
282 St. Catherine Street West, MONTREAL

WALKER'S ELECTRIC BOILER COMPOUND

Ensures A Scale-Free Boiler

It will rid your boilers of ALL scale; and, if used regularly, will KEEP your boilers absolutely free from scale without the slightest injury to the boilers or pumps.

Give it a trial.

If you do not find it exactly as we claim we cancel the charge against you.

Regal Valve Oil
Red Star Cylinder Oil
Monarch Cylinder Oil
Superior Engine Oil
Electric Engine Oil
Vulcan Machine Oil
Heavy Red Machine Oil
Brush Dynamo Oil
Gas Engine Oil and
all Engine Supplies.

Our **High Grade Oils** will prove of great value to the power plant. They are the result of much experimenting, and we believe, they are the best value on the market.

Write for Samples.

The Electric Boiler Compound COMPANY, LIMITED

Guelph, - - Ontario

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Kerr Engine Co., Walkerville, Ont.
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Watson & McDaniel Co. Philadelphia

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Can. Fairbanks-Morse Co., Montreal.
Elliott Co., Pittshurgh, Pa.
Engineering Specialties Co., Toronto.
General Supply Co. of Can., Ottawa.
Lunkenheimer Co., Cincinnati, O.
H. L. Peiler & Co., Montreal.
Watson & McDaniel Co. Philadelphia

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Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Valves, Reducing.
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Goldie & McCulloch Co., Galt.

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Canadian General Electric Co., Ltd., Toronto.
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Elliott Co., Pittsburgh, Pa.
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Liberty Mfg. Co., Pittsburgh, Pa.

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Hare Eng. Co., Toronto.
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Geo. W. Lord Co., Philadelphia, Pa.

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Franco-Can. Welding Co., Toronto.

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Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

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THIS directory is run every month at considerable expense for the benefit of our army of readers—your benefit.

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¶ Turn from this directory to our advertising pages and study carefully what our advertisers say regarding their product.

¶ You do not derive half the benefit from any one issue of "The Power House" until you have studied the advertising pages.

¶ The manufacturer who is spending his life in perfecting his product, tells you there just what he has that is going to help you get better results from your plant.

¶ And getting better results is going to increase the size of your weekly envelope.

¶ Look over this issue carefully—then look over your plant. You're sure to discover some things advertised that, if installed in your plant, would help to put you in right with the boss.

Use "THE POWER HOUSE" Directory—you will find it complete and you will help your favorite Journal.

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MONTREAL CANADA

Bare and Insulated Electric Wire

Electric Light Line Wire. Incandescent or Flexible Cords.

Railway Feeder and Trolley Wire

Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.

HALIFAX TORONTO WINNIPEG VANCOUVER

NEWTYPE BERGMANN LAMPS

(Tungsten Filament)

THE UNBREAKABLE KIND

Are now ready for delivery. We guarantee delivery to you in good condition.

EXCLUSIVE CANADIAN DISTRIBUTOR:

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Live Agents wanted all over Canada. 329 Craig Street West MONTREAL

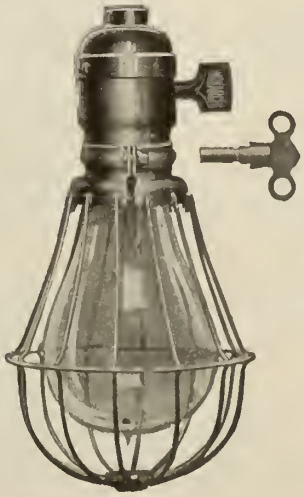
MONARCH ELECTRIC CO., Limited

ST. LAMBERT, P.Q.

District of Montreal.

WE GIVE SATISFACTION

SEVERAL LINES WE MANUFACTURE AND CARRY IN STOCK



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The Davis Improved Steam Trap

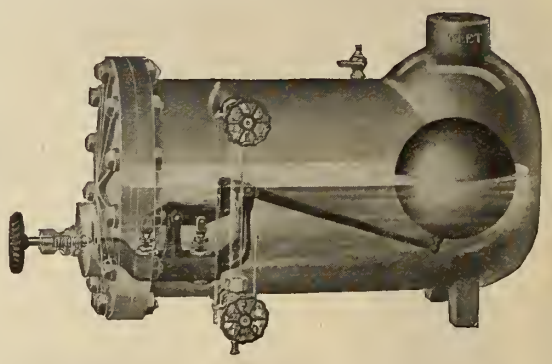
The Davis is a general service trap. Its purpose is the automatic removal of the water of condensation from steam pipes or any steam receptacle without the loss of steam.

It is not a boiler return trap, but will discharge into the atmosphere or against any pressure less than the pressure under which it is being operated.

Having double balanced valves it has an nnnsually large capacity and may be used under any pressure from 1 to 200 ponnds. Its vital parts—the valves and seats—are renewable and are made of Tobin Bronze, a non-corrosive metal that is practically as hard as steel. This construction adds greatly to its durability and facilitates repairs when they are necessary.

The valves are conical in form with long bevel and are not guided by sleeves. When open they are loose in the seats, hence cannot stick or become clogged with sediment, scale, grease or other foreign matter. All working parts are attached to the cover and removable with it, without breaking either inlet or outlet connections.

Send for 15 page booklet of the Davis Trap and let us quote you on the traps you need.



New York
123 Liberty Street

St. Louis
735 South Fourth Street

Pittsburgh
Park Building

G. M. Davis Regulator Company

Established 1875

434 Milwaukee Avenue, Chicago

Manufacturers of the Davis Stop and Check Valve, Back Pressure Valve, Steam Trap, Exhaust Relief Valve, Balanced Valve, Float Valve, Pump Governor and other Specialties.

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2528 No. American St.

Boston
70 High Street

San Francisco
Rialto Building

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Westinghouse

Alternating-Current, Engine Type Generators

Design
Material
Workmanship

have each contributed to the unqualified success of these generators. They are intended for direct mounting on the shafts of steam, gas or oil engines, and are made in standard capacities ranging from 50 to 1,100 kva.

They are rugged, smooth running, and carry heavy, continuous overloads at low power factors. Units totalling many thousands kva. in daily operation attest their reliability in service.—See Circular No. 1190.

Canadian Westinghouse Co., Limited, Hamilton, Ontario

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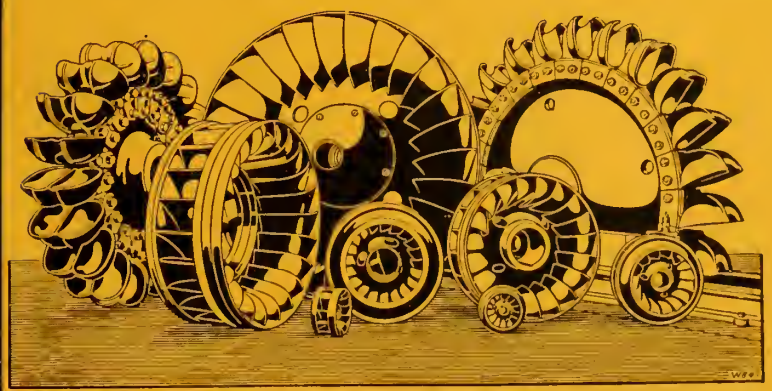
ESCHER-WYSS-WATER-WHEELS
TURBINES AND IMPULSE-WHEELS

HEAD OFFICE FOR CANADA:

515 Canadian Express Bldg.,

MONTREAL, Que.



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MAN., SASK., ALTA.

C. L. Trimingham, 45 Canada Life Bldg., Winnipeg, Man.

BRITISH COLUMBIA:

Frank Darling & Co., Homer Street, Vancouver, B.C.

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Minimize Your Boiler Room Troubles

by using

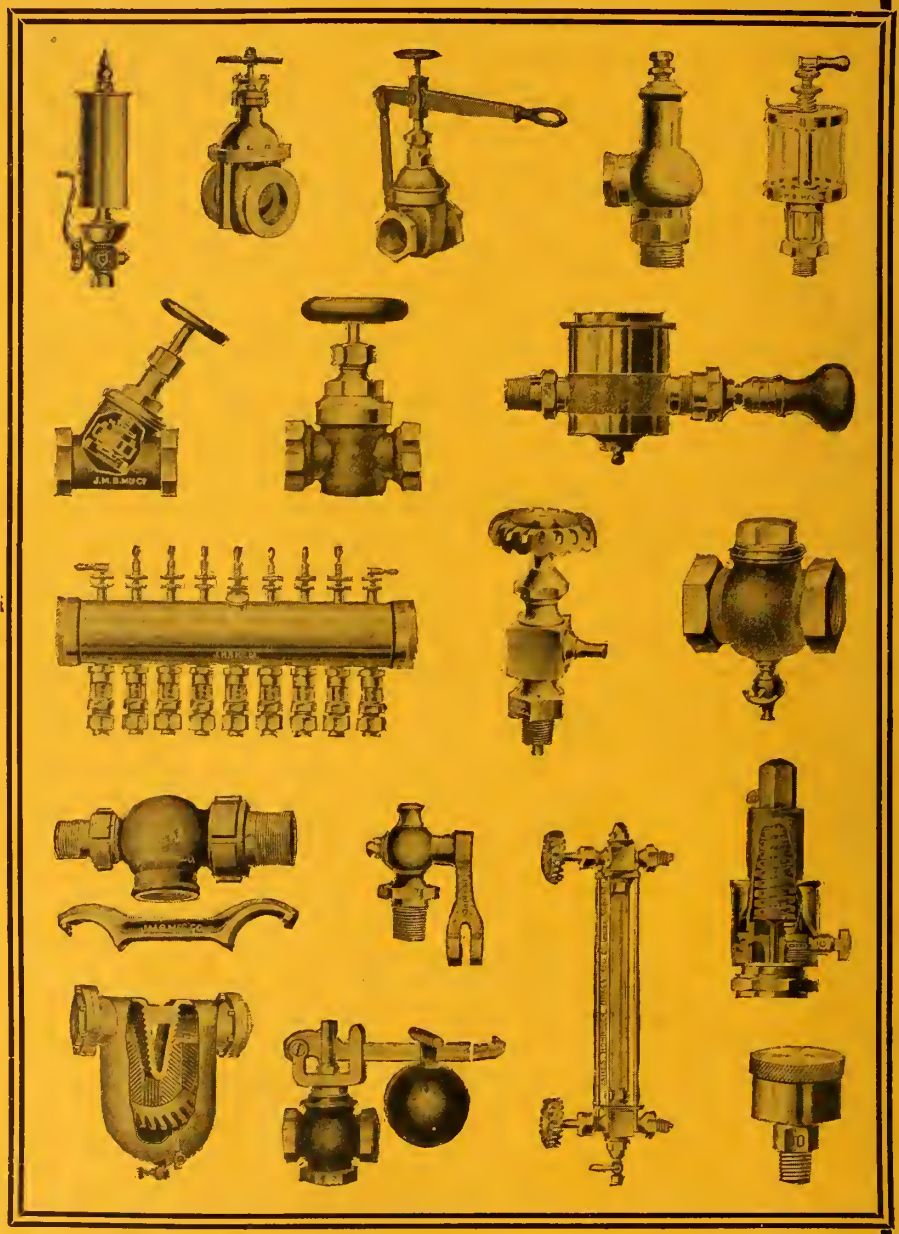
MORRISON'S Engineers' Supplies

The Cuts herewith illustrate a few of our products in the line of Engineers' Supplies.

We submit our goods as first in quality of material and workmanship, and guaranteed to "stand up" against the most rigid test covering the duties for which they are made to be used.

We solicit your enquiries for anything in the steam and valve goods lines.

Catalogue to the trade and large user.



The James Morrison Brass Mfg. Co., Limited

93-97 Adelaide Street West, TORONTO